APPENDIX A
CORRESPONDENCE

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DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
(INSTALLATIONS AND ENVIRONMENT)
1000 NAVY PENTAGON
WASHINGTON DC 20350-1000

November 14, 2008

MEMORANDUM FOR THE DEPUTY CHIEF OF NAVAL OPERATIONS FOR INTEGRATION OF CAPABILITIES AND RESOURCES (N8)

SUBJECT: SURTASS LFA Sonar Supplemental Eis/Supplemental OEIS

I previously reviewed the Final Supplemental Environmental Impact Statement (Final SEIS) for the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar and the August 15, 2007 Record of Decision (ROD) concerning the continued employment of SURTASS LFA sonar systems. I found that the analysis of the Final SEIS took the requisite "hard look" at the environmental consequences of the decision to employ SURTASS LFA sonar systems and that the ROD adequately addressed issues raised.

Due to recent concerns raised during litigation over employment of the SURTASS LFA Sonar system, and to support issuance of a new Final Rule under the Marine Mammal Protection Act (MMPA) for employment of SURTASS LFA sonar systems, I have determined that the purposes of the National Environmental Policy Act (NEPA) and Executive Order 12114 (Environmental Effects Abroad of Major Federal Actions) would be furthered by the preparation of additional supplemental analysis related to the employment of the system. This analysis should take the form of a new SEIS / supplemental overseas environmental impact statement (SOEIS).

Based on discussions with the Department of Justice, the new SEIS/SOEIS must provide further analysis of potential additional offshore (greater than 12 nm) biologically important areas (OBIAs) in regions of the world where the Navy intends to use the SURTASS LFA sonar systems for routine training, testing, and military operations. The phrase "military operations" does not include use of SURTASS LFA in armed conflict or direct combat support operations nor to use of SURTASS LFA during periods of heightened threat conditions as determined by the National Command Authorities. The new SEIS/SOEIS also must include further analysis of whether using a larger coastal standoff distance is practicable where the continental shelf extends further than the current standoff distance, and further analysis of cumulative impacts involving other active sonar sources. Once completed, information developed from these analyses will be used to assist the Navy in determining how to employ SURTASS LFA sonar, including the selection of operating areas that the Navy requires for routine training, testing, and military operations in requests for MMPA Letters of Authorization (LOAs) submitted to the National Marine Fisheries Service.

Please ensure that the supplemental analysis as discussed above complies with both the NEPA and Executive Order 12114. My point of contact for this supplemental analysis is Captain Dean Leech, JAGC, USN. He can be reached at (703) 614-3137 or dean.leech@navy.mil.

DONALD R. SCHREGARDUS
Deputy Assistant Secretary of the Navy
(Environment)

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DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, DC 20350

IN REPLY REFER TO
9462
Ser N872A/8U179097
24 November 08

From: Chief of Naval Operations
Head, Undersea Surveillance Branch (N872A)
To: Director, Office of Protected Resources
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
1315 East-West Highway
Silver Spring, Maryland 20910

Subj: COOPERATING AGENCY REQUEST FOR SURTASS LFA SONAR SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT

Ref: (a) Deputy Assistant Secretary of the Navy (Environment) Memorandum for the Deputy Chief of Naval Operations for Integration of Capabilities and Resources (N8) SURTASS LFA Sonar Supplemental EIS/Supplemental OEIS, 14 November 2008

1. In reference (a), the Deputy Assistant Secretary of the Navy for Environment directed the Navy to prepare a supplemental environmental impact statement (SEIS)/supplemental overseas environmental impact statement (SOEIS) for the employment of the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar to address concerns raised by the court in recent litigation and to support a new 5-Year Final Rule under the Marine Mammal Protection Act (MMPA) for employment of SURTASS LFA sonar.

2. In preparation for the important work ahead in developing the SEIS/SOEIS, the Navy requests that the National Marine Fisheries Service (NMFS) serve as a cooperating agency in accordance with National Environmental Policy Act (NEPA) regulations (40 CFR 1501.6) and the Council on Environmental Quality Cooperating Agency guidance issued on January 30, 2002.

3. The Navy will be responsible for overseeing preparation of the SEIS/SOEIS, which includes but is not limited to:

- Gathering all necessary background information and preparing the SEIS/SOEIS and all necessary permit applications associated with the employment of the SURTASS LFA sonar.
- Working with NMFS personnel in determining and applying the best available science in the analyses in the SEIS/SOEIS.
- Responding to NMFS requests for information in a timely manner.
- Circulating the NEPA/Executive Order 12114 documentation to the general public and any other interested parties.

Subj: COOPERATING AGENCY REQUEST FOR SURTASS LFA SONAR SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT

- Maintaining the SEIS/SOEIS schedule and supervising meetings held in support of the NEPA/Executive Order 12114 process.
- Compiling and drafting responses to comments received on the Draft SEIS/SOEIS.

4. As a cooperating agency, the Navy requests that NMFS provide the following support:

- Provide timely comments on working drafts of the SEIS/SOEIS.
- Coordinate closely with the Navy to identify potential additional offshore (greater than 12 nm) biologically important areas (OBIAs) in regions of the world where the Navy anticipates the potential use of SURTASS LFA sonar for routine training, testing, and military operations.
- Respond to Navy requests for information in a timely manner.
- Coordinate, to the maximum extent practicable, any public comment periods that are necessary in the permitting process under the MMPA for the new 5-Year Final Rule with the NEPA comment period on the SEIS/SOEIS.
- Assist the Navy in responding to public comments.
- Participate in meetings hosted by the Navy for discussions of the SEIS/SOEIS and permitting related issues.
- Adhere, to the maximum extent possible, to the overall project schedule as agreed upon by the Navy and NMFS.

5. The Navy views this agreement as important to the successful completion of the SURTASS LFA Sonar SEIS/SOEIS. It is the Navy's goal to complete the analysis as expeditiously as possible, while using the best scientific information available. NMFS participation as a cooperating agency is greatly desired and will be invaluable in this endeavor. A formal, written response is requested.

6. We look forward to a continuation of the past positive and productive interactions between personnel from my office and the NMFS Office of Protected Resources. This cooperation has been largely responsible for the timely completion of complex NEPA documents and the issuance of required permits that have allowed the Navy to test, train and operate underwater surveillance systems critical to our national security.

7. The CNO point of contact is LCDR Neil Smith (N872A), who can be reached at 703-604-6333, E-mail: neil.t.smith@navy.mil.

J. S. Currer
Captain, U. S. Navy

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910
THE DIRECTOR

FEB 0 6 2009

Captain J.S. Currer
Head, Undersea Surveillance Branch (N872A)
Office of the Chief of Naval Operations
2000 Navy Pentagon
Washington, D.C. 20350-2000

Dear Captain Currer:

Thank you for your letter (Ser N872A/8U179097) requesting that NOAA's National Marine Fisheries Service (NMFS) participate as a cooperating agency in the preparation of a Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (Supplemental EIS/OEIS) for the operational deployment of the Surface Towed Array Surveillance System Low Frequency Active (SURTASS LFA) Sonar. The Final EIS/OEIS for SURTASS LFA sonar was completed in 2001 (65 FR 8788) and a Supplemental Final EIS/OEIS was completed and made available to the public on May 4, 2007 (72 FR 25302). NMFS supports the Navy's decision to prepare an additional Supplemental EIS/OEIS to analyze specific aspects of the proposed SURTASS LFA sonar activity, and agrees to be a cooperating agency, due, in part, to our responsibilities under section 101(a)(5)(A) of the Marine Mammal Protection Act and section 7 of the Endangered Species Act.

This cooperating agency role is entered in accordance with the Council on Environmental Quality's National Environmental Policy Act implementing regulations (specifically, 40 CFR 1501.6). We agree with the list of responsibilities for the Navy and NMFS identified in your letter, to ensure successful and timely completion of the subject Supplemental EIS/OEIS.

My staff looks forward to meeting with you soon to develop the cooperating agency responsibilities and schedules in more detail. In the meantime, should you need any additional information, please contact Kenneth Hollingshead or Jeannine Cody (301/713-2289, ext 128 or 113), who will be the NMFS points of contact for this Supplemental EIS/OEIS.

Sincerely,

James W. Balsiger, Ph.D.
Acting Assistant Administrator
for Fisheries

THE ASSISTANT ADMINISTRATOR
FOR FISHERIES

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Appendix B

REPRESENTATIVE MARINE AND FRESHWATER FISH TAXA (ORDERS) AND THEIR HEARING CAPABILITIES

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Table B-1. Representative marine and freshwater fish taxa (by Order) and their hearing capabilities.

FISH ORDER	COMMON NAME (REPRESENTATIVE SPECIES FOR ORDER)	PELAGIC OR DEMERSAL	HEARING CHARACTERISTICS[1]
Heterodontiformes	Bullhead Sharks	Demersal	The horn shark, *Heterodontus francisci*, reportedly hears from 20 to 160 Hz (Kelly and Nelson, 1975).[2] Casper and Mann (2007) showed detection from 20 to around 400 Hz in this species and provided particle motion data.
Orectolobiformes	Carpet Sharks	Demersal	The nurse shark *Ginglymostoma cirratum* is able to detect sounds to above 1 kHz with best sensitivity below about 400 Hz (Casper and Mann, 2006). Casper and Mann (2007) measured hearing in white-spotted bamboo shark, *Chiloscyllium plagiosum*, and determined particle motion thresholds from about 20 Hz to 400 Hz, with best sensitivity at the lower frequencies.

[1] It is suggested that whereas the hearing bandwidth and general sensitivity trends are generally valid, the “details” of the specific bandwidth and hearing sensitivity must be viewed with some caution in all species reported. In particular, the data reported here were obtained using a wide range of methods and so some of the differences among species may reflect the experimental approach more than real differences. For example, while the lowest frequency detectable is given, careful analysis of the original papers will show that the lower frequency is often related to the methods used to produce sounds. Thus, a lower limit of 50 or 100 Hz may reflect that the sound sources used in the experiments could not produce sounds below that frequency, whereas if a different sound system were used the fish may have actually been able to respond to lower frequencies. This is less of a problem with the upper frequency limits for hearing since sound systems used in most studies often could produce much higher frequencies than tested. The other caveat in these data is the actual threshold (lowest detectable sound). The “threshold” is defined as the signal that is detectable only a certain percent of the time (e.g., often 50 percent). Moreover, thresholds may vary within an individual based upon motivation and other factors. Finally, and significantly, many of the earlier studies were done with less than ideal acoustics and whereas the thresholds reported may have been based upon pressure signals, the fish themselves may have been responding to the particle displacement component of the sound field.

[2] Data for sharks and rays and for a number of bony fish have only been obtained for a few specimens. Future research is needed to replicate these results on both threshold and bandwidth.

Table B-1. Representative marine and freshwater fish taxa (by Order) and their hearing capabilities.

Fish Order	Common Name (Representative Species for Order)	Pelagic or Demersal	Hearing Characteristics[1]
Lamniformes	Pelagic Sharks	Pelagic	Hearing range for the bull shark, *Carcharhinus leucas*, reportedly is 100 to 1400 Hz (Kritzler and Wood, 1961), the lemon, *Negaprion brevirostris,* hears from 10 to 640 Hz (Banner, 1967; Nelson, 1967; Banner, 1972), and the hammerhead shark, *Sphyrna lewini*, from 250 to 750 Hz (Olla, 1962). Data from shark attraction experiments suggest hearing up to 1500 Hz in a number of species, although these data are not quantified and should be repeated.[2]
Rajiformes	Skates and Rays	Demersal	The little skate, *Raja erinacea*, hears from 100 to 800 Hz, with best hearing at 200 Hz at approximately 122 dB re 1 µPa @ 1 m threshold (Casper et al., 2003). The yellow stingray, *Urobatis jamaicensis*, detects sounds to about 1 kHz with best sensitivity below 400 Hz (Casper and Mann, 2006).
Anguilliformes	Eels	Demersal	The upper audible limit of *Anguilla anguilla* hearing is reported to be about 600 Hz with best hearing at about 100 Hz at 95 dB re 1 µPa @ 1 m threshold (Jerkø et al., 1989). There is some evidence that *Anguilla* can detect infrasound (signals below about 30 Hz) but only when the source is within a few body lengths of the fish (Sand et al., 2000).
Albuleiformes	Bonefish	Pelagic and Demersal	The bonefish (*Albula vulpes*) detects sounds from 50 to 700 Hz (Tavolga, 1974).

Table B-1. Representative marine and freshwater fish taxa (by Order) and their hearing capabilities.

FISH ORDER	COMMON NAME (REPRESENTATIVE SPECIES FOR ORDER)	PELAGIC OR DEMERSAL	HEARING CHARACTERISTICS[1]
Clupeiformes	Herrings/Shads/Sardines/Anchovies	Pelagic	Maximum hearing sensitivity for Pacific herring (*Clupea harengus pallasi*) is reportedly 125 to 500 Hz (reviewed in Croll et al., 1999), Pacific sardine (*Sardinops sagax*) best sensitivity is reported to be from 63 to 500 Hz (Sonalysts, 1995–unpublished "gray" literature). Spotlined sardines (*Sardinops melanostictus*) are reported to hear from 256 to 2048 Hz, with maximum sensitivity near 1 kHz (Akamatsu et al., 2003). Maximum sensitivity for spotted shad (*Clupanodon punctatus*) is 125 to 500 Hz (Sorokin et al., 1988). All of these data are highly suspect, and most clupeiforms appear to detect sounds to over 3 kHz (Mann et al., 2001 and 2005) and some species in the genus *Alosa* can detect sounds to over 180 kHz (Mann et al., 1998 and 2001). There is a report that the twaite shad (*Alosa fallax*) avoided 200 kHz sound pulses (Gregory and Clabburn, 2003).
Salmoniformes	Salmons/Trout/Chars	Pelagic	Some species (e.g. *Salmo salar*) are able to detect sounds from 30 Hz to about 600 Hz (Hawkins and Johnstone, 1978; Knudsen et al., 1992). Recent studies show that rainbow trout (*Oncorhynchus mykiss*) appear to be able to detect sounds to over 800 Hz (Popper et al., 2007; Wysocki et al., 2007). A similar hearing range is detectable by the broad whitefish (*Coregonus nasus*) (Popper et al., 2005b).

Table B-1. Representative marine and freshwater fish taxa (by Order) and their hearing capabilities.

Fish Order	Common Name (Representative Species for Order)	Pelagic or Demersal	Hearing Characteristics[1]
Gadiformes	Cods/Hakes/Haddock/Pollock	Pelagic and demersal	Hearing range of the cod (*Gadus morhua)* is 10 to 500 Hz (Chapman and Hawkins, 1973), while that of the haddock (*Melanogrammus aeglefinus*) range from 30 to 470 Hz (Chapman, 1973). Pollack (*Pollachius polachius*) hear about the same range of sounds (Chapman, 1973). Walleye pollock (*Theragra chalcogramma*) are reported to be able to detect sounds from 60 to 1000 Hz, with best hearing at 120 to 200 Hz (Park et al., 1995), although Mann et al., (2009) more recently demonstrated that upper hearing was more likely limited to 450 Hz. The ling (*Molva molva*) reportedly detects sounds from 40 to 550 Hz (Chapman, 1973). There is evidence that the burbot, *Lota lota*, can detect sounds to over 1,500 Hz (Mann et al., 2007).
Pleuronectiformes	Flounders/Sole/Halibut	Demersal	*Pleuronectes platessa* and *Limanda limanda* reportedly detect sounds up to 200 Hz (Chapman and Sand, 1974), while *Pleuronectes* is able to detect sounds as low as 30 or 40 Hz (Karlsen, 1992a). *Paralichthys olivaceous* detects sounds from 70 to 500 Hz, with best hearing at 100 Hz (Fujieda et al., 1996). *Pleuronectes yokohamae* is able to detect sounds from 60 to 1000 Hz, with best hearing at 100 Hz (Zhang et al., 1998).
Beryciformes	Squirrelfish (Holocentridae)	Pelagic and demersal	One species of squirrelfish (*Myripriste kuntee*) can detect sounds between 100 to 3,000 Hz with best sensitivity between 300 to 2,000 Hz, while another species (*Adioryx xantherythrus*) can only detect from about 100 to 1000 Hz (Coombs and Popper, 1979). The squirrelfishes (*Holocentrus vexillaris* and *Holocentrus ascensionis*) can detect sounds from 100 to 1200 Hz (Tavolga and Wodinsky, 1963; Wodinsky and Tavolga, 1964). Large variability in hearing capabilities exists within this group of fish.

Table B-1. Representative marine and freshwater fish taxa (by Order) and their hearing capabilities.

Fish Order	Common Name (Representative Species for Order)	Pelagic or Demersal	Hearing Characteristics[1]
Batrachoidiformes	Toadfish (Batrachoididae)	Demersal	Oyster toadfish (*Opsanus tau*) reportedly detect sounds from 40 to 700 Hz, with best sensitivity between 40 to 200 Hz (Fish and Offutt, 1972), which has been confirmed from neurophysiological studies (Fay and Edds-Walton, 1997). Measures of hearing using auditory brainstem response show a similar hearing range in the Lusitanian toadfish, *Halobatrachus didactylus* (Vasconcelos et al., 2007).
Scorpaeniformes	Searobins (Triglidae)	Demersal	Slender searobin (*Prionotus scitulus*) detects sounds from 100 to 600 Hz, with best sensitivity from 200 to 400 Hz (Tavolga and Wodinsky, 1963).
Perciformes (This is such a diverse group of fish that they are broken down by taxonomic family)	Tunas (Scombridae)	Pelagic and Demersal	Yellowfin tuna (*Thunnus albacares*) hearing ranges from 50 to 1,100 Hz, with most sensitive hearing between 300 and 500 Hz (Iverson, 1967). This species has much better sensitivity than another tuna, the kawakawa (*Euthynnus affinis*), which has the same hearing range (Iverson, 1967).
	Damselfish (Pomacentridae)	Demersal	Various species in this family (genus *Eupomacentrus*) can detect sounds from 100 to 1200 Hz, with best hearing from 300 to 600 Hz (Myrberg and Spires, 1980).
	Wrasses (Labridae)	Pelagic and Demersal	Very diverse group and not likely that data for limited number of species represent variation in hearing likely to be found. However, blue-head wrasse (*Thalassoma bifasciatum*) can detect sounds from 100 to 1200 Hz, with best sensitivity from 200 to 600 Hz (Tavolga and Wodinsky, 1963).
	Sea basses (Serranidae)	Pelagic and Demersal	Only data are for the red hind (*Epinephelus guttatus*) report hearing from 100 to 1,000 Hz, with best sensitivity from 200 to 400 Hz (Tavolga and Wodinsky, 1963).
	Snappers (Lutjanidae)	Pelagic and Demersal	Schoolmaster (*Lutjanus apodus*) hears from 100 to 1000 Hz, with best sensitivity from 200 to 600 Hz. (Tavolga and Wodinsky, 1963).

Table B-1. Representative marine and freshwater fish taxa (by Order) and their hearing capabilities.

Fish Order	Common Name (Representative Species for Order)	Pelagic or Demersal	Hearing Characteristics[1]
Perciformes (Continued)	Drums (croakers) (Sciaenidae)	Pelagic and Demersal	There is broad diversity in ear structure and in hearing in this group (Ramcharitar et al., 2001 and 2004; Ramcharitar and Popper, 2004). Several species can detect sounds to over 2,000 Hz, while others can only detect sounds to 800 Hz. Many sciaenids use sound for communication as well.
	Grunts (Haemulidae)	Demersal	Blue-striped grunt (*Haemulon sciurus*) hears from 50 to 1,000 Hz, with best hearing from 50 to 500 Hz (Tavolga and Wodinsky 1963 and 1965).
	Breams and Porgies (Sparidae)	Pelagic	Ringed sea-bream (*Sargus annularis*) reportedly hears from 400 to 1,200 Hz, with best hearing from 400 to 800 Hz (Dijkgraaf, 1952). Red sea-bream (*Pagrus major*) hears from 50 to 1500 Hz, with best hearing at 200 Hz (Ishioka et al., 1988; Iwashita et al., 1999). Pinfish (*Lagodon rhomboides*) hears from 100 to 1000 Hz, with best sensitivity at 300 Hz (Tavolga, 1974).
	Jacks and mackerels (Carangidae)	Pelagic	Horse mackerel (*Trachurus japonicus*) hears 70 to 3,000 Hz, with best hearing at 1,000 to 1,500 Hz (Chung et al., 1995).
	Sleeper gobies (Eleotridae)	Demersal	Sleeper goby (*Dormitator latifrons*) detects frequencies from 50 to 400 Hz (Lu and Xu, 2002).
	Goatfish (Mullidae)	Dermersal	Hearing ability in *Mullus* has greatest sensitivity occurring at 450 to 900 Hz (Maliukina, 1960).
	Mullet (Mugilidae)	Pelagic	Hearing ability in *Mugil* has an upper frequency limit of 1,600 to 2,500 Hz, with greatest sensitivity occurring at 640 Hz (Maliukina, 1960).

Table B-1. Representative marine and freshwater fish taxa (by Order) and their hearing capabilities.

FISH ORDER	COMMON NAME (REPRESENTATIVE SPECIES FOR ORDER)	PELAGIC OR DEMERSAL	HEARING CHARACTERISTICS[1]
	Gobies (Gobiidae)	Demersal	Hearing ability in *Gobius* has an upper frequency limit of 800 Hz, (Dijkgraaf, 1952).
Siluriformes	Catfish	Demersal	Marine catfish (*Arius felis*) hears from 50 to 1,000 Hz, with best hearing from 100 to 400 Hz (Popper and Tavolga, 1981). *Amiurus nebulosus* hears from 60 to 10,000 Hz with best hearing at 400 to 1,500 Hz (Poggendorf, 1952).

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APPENDIX C
MARINE MAMMAL IMPACT ANALYSIS
AND
HARASSMENT LEVEL CALCULATION

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C-1.0 INTRODUCTION

As previously discussed in Chapter 4 of this SEIS/SOEIS, the types of potential effects on marine mammals from SURTASS LFA sonar operations include: 1) non-auditory injury; 2) permanent loss of hearing; 3) temporary loss of hearing; 4) behavioral change; and 5) masking. Richardson et al. (1995b) provided the most comprehensive review of contemporary knowledge on the sources and effects of anthropogenic noise on marine mammals, and Nowacek et al. (2007) provide a more recent review of the effects of anthropogenic noise on cetaceans. Nowacek et al. (2007) included an update on the documented behavioral, acoustic, and some physiological responses of cetaceans to man-made noise, and focused on literature that reported quantitatively on the sound field and some indicator of response. Southall et al. (2007) reported on the results from a panel of acoustic research experts in the behavioral, physiological, and physical disciplines. The panel's purpose was to review the expanding literature on marine mammal hearing, as well as physiological and behavioral responses to anthropogenic sound with the objective of proposing exposure criteria for certain effects.

References to Underwater Sound Levels

- **References to underwater sound pressure level (SPL) in this SEIS/SOEIS are values given in decibels (dBs), and are assumed to be standardized at 1 microPascal at 1 m (dB re 1 µPa @ 1 m [rms]) for source level (SL) and dB re 1 µPa (rms) for received level (RL), unless otherwise stated (Urick, 1983; ANSI, 2006).**
- **In this SEIS/SOEIS, underwater sound exposure level (SEL) is a measure of energy, specifically the squared instantaneous pressure integrated over time and expressed as an equivalent one-second in duration signal, unless otherwise stated; the appropriate units for SEL are dB re 1 µPa²-sec (Urick, 1983; ANSI, 2006; Southall et al., 2007).**
- **The term "Single Ping Equivalent" (SPE) (as defined in Chapter 4 and Appendix C of this SEIS/SOEIS) is an intermediate calculation for input to the risk continuum used in this document. SPE accounts for the energy of all the LFA acoustic transmissions that a modeled animal receives during an entire LFA mission (modeled for operations from 7 to 20 days). Calculating the potential risk from SURTASS LFA is a complex process and the reader is referred to Appendix C for details. As discussed in Appendix C, SPE is a function of SPL, not SEL. SPE levels will be expressed as "dB SPE" in this document, as they have been in the SURTASS LFA sonar FOEIS/FEIS and FSEIS documents (DoN, 2001 and 2007a).**

The first two potential effects from SURTASS LFA sonar listed above (i.e., non-auditory physical effects and permanent loss of hearing) are typically grouped together and constitute "injury effects" or Level A harassments as defined under the MMPA. As previously discussed, Southall et al. (2007) proposed a dual injury criteria for individual low frequency (LF)/mid-frequency (MF)/high frequency (HF) marine mammal groups exposed to non-pulsed sound type, which included discrete acoustic exposures from SURTASS LFA sonar, and consists of an SPL and an SEL criteria. Due to the long duration of the LFA signal (i.e., nominally 60 sec), the SEL criterion from Southall et al. (2007) is always the dominant of the dual criteria identified there. Thus, the proposed injury criteria, which are based on onset of PTS, for LF/MF/HF cetaceans are a sound exposure level (SEL) of 215 dB re 1 µPa²-sec and for pinnipeds in water an SEL of 203 dB re 1 µPa²-sec. The current and historic SURTASS LFA sonar acoustic analyses have established and maintained a threshold of injury, or Level A harassment, to occur for an SPE received level (RL) ≥180 dB SPE. A comparison of the Southall et al. (2007) PTS SEL criterion and the 180 dB SPE can be made by adjusting the Southall et al. (2007) criterion for the longer LFA signal (nominally 60 sec), using 10 Log (T/Ti) where T is 60 sec and Ti is 1 sec. Thus, an 18-dB adjustment is made to the Southall et al. (2007) criterion, resulting in an SEL injury criterion for SURTASS LFA sonar of 197 dB re 1 μPa²-sec RL for cetaceans. For pinnipeds in water, this adjusted value would be an SEL of 185 dB re 1 μPa²-sec RL. The SURTASS LFA sonar injury criterion for all marine mammals of 180 dB SPE is conservative when compared to the adjusted Southall et al. (2007) SEL values above and it would be even more conservative if compared to the Southall et al. (2007) SPL criteria of 230 and 218 dB SPL for cetaceans and pinnipeds, respectively. An additional potential effect, masking, has been addressed in Chapter 4.

Additionally, based on simple spherical spreading (i.e., a transmission loss [TL] based on 20×Log10 [range in meters]) and assuming that the LFA array is a point source, a cetacean would need to approach and remain within approximately 33 m (108 ft) of the LFA source array (while a pinniped would need to be within 130 m [427 ft] of the array, which is approximately 76 m [250 ft] deep) for the complete 60 sec of the transmission, without detection, in order to exceed the Southall et al. (2007) injury thresholds. Based on the mitigation enacted during LFA transmission operations, the chances of this occurring are negligible and therefore will not be further discussed in this appendix. In addition, since the array is not a point source, these very short ranges (i.e., 33 and 130 m) are actually conservative values because at these ranges, the animal would still be in the near-field of the array (i.e., where the individual source elements are still affecting each others' signal and the theoretical source level calculated for a point source with a beam pattern over-predicts the actual source levels observed).

The next two potential effects listed above (i.e., temporary loss of hearing and behavioral change) are also typically grouped together and constitute "non-injury or harassment effects" or Level B harassments as defined in the MMPA. In the 2002 and 2007 SURTASS LFA Sonar Final Rules (NOAA, 2002a and 2007c), NMFS stated that TTS is not an injury. The underlying scientific studies and reports that have been detailed in Chapter 4 of this document show the potential impacts to marine mammal hearing varies not only from species to species but also from animal to animal within a species. Thus the utilization of a risk continuum to attempt to capture the variability of acoustic impacts to a species, as was first done for U.S. Navy environmental compliance documents in the SURTASS LFA sonar FOEIS/EIS (DoN, 2001), has become the standard approach for the U.S. Navy. This appendix is designed to document the details of that analysis effort for this SEIS/SOEIS.

A description and application of the risk continuum used in the analysis for this document is included in this appendix. The original application of a risk continuum in Navy documents occurred with the first SURTASS LFA FOEIS/EIS (DoN, 2001), which has been incorporated into this document by reference. The Navy, however, has since expanded the use of risk continuums to other documents. The current Navy standards as specified by CNO (N45) for assessing acoustic impacts requires the use of a risk continuum function (as was done in the SURTASS LFA Sonar FOEIS/EIS, Hawaii Range Complex (HRC) FEIS/OEIS, the Southern California Range Complex (SOCAL) FEIS/OEIS, and Atlantic Fleet Active Sonar Training (AFAST) FEIS/OEIS [(DoN, 2001, 2008a, b, c)] to calculate the potential impacts from acoustic sources. However, the Navy standard risk continuum and its implementation as used for the Mid-Frequency Active (MFA) systems in these three FOEIS/OEISs differs from the LFA risk continuum and subsequent take calculations in several ways including: a) the use of an SPL (MFA) vice an SPE (LFA) as a starting argument into the risk function; b) the period of time integrated for each entry into the risk continuum; and c) the details of the criteria for the categories of potential impact. In general, the LFA risk continuum function is a means of predicting the potential behavioral impacts associated with underwater acoustic operations on marine mammal species near the operational area of sonar systems. The inputs to the LFA risk continuum are typically the amount of acoustic exposure an animal is likely to receive during the proposed operation (energy is integrated over all exposures received during a 7 to 20 day mission).

To determine the likely acoustic exposure, the movement of animals in the area is modeled along with the acoustic field generated by the sonar system(s). This appendix addresses the acoustic modeling performed for the additional 19 potential LFA operating areas documented in the SEIS/SOEIS.

C-2.0 ACOUSTIC IMPACT MODELING

For convenience, the details of the modeling conducted for this SEIS/SOEIS are provided in Subsections C-2.1 through C-2.4. Subsections C-2.5 through C-2.8 provide the historical and scientific data supporting the general use and development of the LFA risk continuum. These later subsections primarily consist of an updated and expanded version of the technical analysis methodology, which can be found in Chapter 4 of the original LFA FOEIS/EIS (DoN, 2001). Finally, this appendix presents a summary of the analysis in Section C-3.0.

For this SEIS/SOEIS, the Acoustic Integration Model© (AIM) was used to simulate the sound field produced by the SURTASS LFA sonar source operations and the correct marine mammal disposition and movement for all of the species present in the 19 different modeled oceanic areas (in addition to the 31 areas that were modeled in the original LFA FOEIS/EIS [DoN, 2001]). AIM integrates these results to ascertain the potential acoustic impacts to each of the marine mammal species present at each site. The sound fields produced by the LFA source in the different areas were modeled based on the system's specifications provided in Chapter 2 of this SEIS/SOEIS (i.e., source level, frequency, source depths, beam pattern, and location of the sonar system). Details of the physical acoustic environment as well as details of marine species' presence and their movement come from numerous sources (described below). The AIM modeling process includes both AIM modeling operations and post-AIM calculations. During the internal AIM modeling, AIM convolves sound field data generated by an embedded acoustic model with animal movement data generated from AIM's animal movement engine. The result data are stored in files and consist of an exposure history for each simulated animal ("animat"). These data are a sequential history as if each animat was fitted with an "acoustic dosimeter" and the resulting received levels from the LFA source were recorded. These exposure data for individual modeled animats are then scaled and summed to predict the risk of harassment for each animal species.

C-2.1 INTRODUCTION TO AIM

AIM is a Monte Carlo-method statistical model. AIM grew out of two earlier models; a whale movement and tracking model developed for the census of the bowhead whale, *Balaena mysticetus* (Ellison et al., 1987), and an underwater acoustic back-scattering model for a moving sound source in an under-ice Arctic environment (Bishop et al., 1987). Since its initial use in a National Environmental Policy Act (NEPA) document in 2001 (DoN, 2001), AIM has had several expansions of underlying databases and models, and the programming code has been improved to allow more detailed and larger simulations. In 2007 the Center for Regulatory Effectiveness (CRE) requested and the National Marine Fisheries Service (NMFS) sponsored a review of AIM by the Center for Independent Experts (CIE). The CIE report found that AIM was fully capable of assessing potential impacts on marine animals.

The exact positions of animals relative to sound sources cannot be known. Multiple runs of realistic predictions are therefore used to provide statistical power for the estimated effects. The movement of sources and receivers (animals) are modeled based on measured or defined data. Each source and receiver is modeled via the animat concept. Animats are computationally simulated animals or objects. When an animat represents an object, such as an acoustic source, the speed, direction, and depth is usually specified. When an animat represents an animal, movement is defined by specifying behavioral variables, such as dive parameters, swimming speed, and course changes (see below). The results are realistic representations of animal movements such as diving patterns that mimic the real-world diving patterns of that species. The movement of an animat can also be programmed to respond to environmental factors (e.g., water depth at the position of the animat). In this way, marine species that normally inhabit a particular environment can be constrained to stay within a specified habitat.

Once the behavior of the animats has been programmed, the simulation is “seeded” with an appropriate number of animats and the model is run. A model run consists of a user-specified number of steps forward in time. During each time step, each animat is moved according to the programmed rules describing its behavior. For each time step, the received sound level at each receiver animat is calculated. At the end of each time step, each animat evaluates its environment including its three-dimensional (3D) location. If an environmental variable has exceeded the user-specified boundary value (e.g., the animat has moved into water that is too shallow), then the animat will alter its course to react to the environment. These responses to the environment are called “aversions.” There are many aversion variables that can be used to specify an animat’s reactions and to obtain realistic behavior (e.g., bathymetry, geographic boundaries, water temperature, density of prey species, and level of pollution).

C-2.2 MARINE MAMMAL OCCURRENCE IN NINETEEN POTENTIAL OPERATION AREAS

To estimate the risk to marine mammals in each of the additional 19 potential SURTASS LFA sonar operation areas, a list of marine mammals likely to be encountered in each region must be developed and abundance and density estimates calculated for each species at each model site. The primary resource for generating a list of marine mammals potentially occurring at each model site was AquaMaps (Kaschner et al,. 2008; http://www.aquamaps.org/search.php). This list was verified with additional published literature specific to each model site. Once the species at a site were determined, they were modeled in AIM at densities higher than those found in the real world in order to sufficiently capture the statistical distribution of potential exposure conditions. Post-processing of the AIM results scaled the modeled densities to the real-world density estimates and divided by the abundance of the population to determine the overall percentage of potential risk to the population.

C-2.2.1 MARINE MAMMAL DENSITY

The distribution of many marine mammal species is irregular and highly dependent upon geography, oceanography, and seasonality. Density and abundance estimates are critical components needed to analytically estimate risk to marine mammal populations from activities occurring in the marine environment. The process for developing density and abundance estimates for every species at the 19 potential operation areas was a multi-step procedure that utilized data with the highest degree of fidelity first. Direct estimates from line-transect surveys that occurred in or near each of the 19 model sites were utilized first (e.g., Barlow, 2006). For the majority of species, abundance estimates were available for each of the 19 model sites (Table C-1). However, density estimates require more sophisticated sampling and analysis and were not always available for each species at all sites. When density estimates were not available from a survey in the operation area, then density estimates from a region with similar oceanographic characteristics were extrapolated to the operation area. For example, the eastern tropical Pacific has been extensively surveyed and provides a comprehensive understanding of marine mammals in temperate oceanic waters (Ferguson and Barlow, 2001, 2003). Further, density estimates are sometimes pooled for species of the same genus if sufficient data are not available to compute a density for individual species or the species are difficult to distinguish at sea. This is often the case for pilot whales and beaked whales, as well as the pygmy and dwarf sperm whales. Density estimates are available for these species groups rather than the individual species (Table C-1). References for density and abundance estimates for each species at each modeled site are provided in Table C-1.

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (Animals)	Stock / Abundance Reference(s)[4]	Density (Animals per km^2)	Density Reference(s)[4]
Site 1: East of Japan					
Blue whale	NP	9,250	1, 2, 3	0.0002	1, 2, 3
Fin whale	NP	9,250	1, 2, 3	0.0002	1, 2, 3
Sei whale	NP	8,600	1	0.0006	1, 2
Bryde’s whale	WNP	20,501	4	0.0006	3
Minke whale	WNP “O” Stock	25,049	5	0.0022	5
North Pacific right whale (spring, fall)	WNP	922	6	<0.00001	
Sperm whale	NP	102,112	7	0.0010	8
Kogia spp.	NP	350,553	9, 10	0.0031	9, 10
Baird's beaked whale	WNP	8,000	11	0.0029	11
Cuvier's beaked whale	NP	90,725	10	0.0054	10
Ginkgo-toothed beaked whale	NP	22,799	9, 10	0.0005	9, 10
Hubbs’ beaked whale	NP	22,799	9, 10	0.0005	9, 10
False killer whale	WNP	16,668	12	0.0036	12
Pygmy killer whale	WNP	30,214	10	0.0021	10
Short-finned pilot whale	WNP	53,608	12	0.0128	12
Risso's dolphin	WNP	83,289	12	0.0097	12
Common dolphin	WNP	3,286,163	9, 10	0.0761	9, 10

3 NP=North Pacific; WNP=Western North Pacific; ENP=Eastern North Pacific; CNP=Central North Pacific; IA=Inshore Archipelago; SOJ=Sea of Japan; ECS=East China Sea; CA/OR/WA=California, Oregon, and Washington; WNA=Western North Atlantic; ENA=Eastern North Atlantic; MED=Mediterranean; WMED=Western Mediterranean; IND=Indian Ocean; XAR=Stock X/Arabian Sea; ETP=Eastern Tropical Pacific; NEOP=Northeastern Offshore Pacific; WSP=Western South Pacific; GVEA=Group V East Australia

4 See end of this appendix table for literature references associated with the numerical values listed in table.

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (animals)	Stock / Abundance Reference(s)[4]	Density (animals per km^2)	Density Reference(s)[4]
Fraser's dolphin	WNP	220,789	9, 10	0.0040	9, 10
Bottlenose dolphin	WNP	168,791	12	0.0171	12
Pantropical spotted dolphin	WNP	438,064	12	0.0259	12
Striped dolphin	WNP	570,038	12	0.0111	12
Spinner dolphin	WNP	1,015,059	9, 10	0.0005	9, 10
Pacific white-sided dolphin	WNP	931,000	9, 10	0.0082	9, 10
Rough-toothed dolphin	WNP	145,729	9, 10	0.0059	9, 10
Site 2: North Philippine Sea					
Bryde's whale	WNP	20,501	4	0.0006	3
Minke whale	WNP "O" Stock	25,049	5	0.0044	5
North Pacific right whale (fall to spring)	WNP	922	6	<0.00001	
Sperm whale	NP	102,112	14	0.0028	15
Kogia spp.	NP	350,553	9, 10	0.0031	9, 10
Cuvier's beaked whale	NP	90,725	10	0.0054	10
Blainville's beaked whale	NP	8,032	9, 10	0.0005	9, 10
Ginkgo-toothed beaked whale	NP	22,799	9, 10	0.0005	9, 10
Killer whale	NP	12,256	9, 10	0.0004	9, 10
False killer whale	WNP	16,668	12	0.0029	12
Pygmy killer whale	WNP	30,214	10	0.0021	10
Melon-headed whale	WNP	36,770	9, 10	0.0012	15
Short-finned pilot whale	WNP	53,608	12	0.0153	12
Risso's dolphin	WNP	83,289	12	0.0106	12
Common dolphin	WNP	3,286,163	9, 10	0.0562	9, 10

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (Animals)	Stock / Abundance Reference(s)[4]	Density (Animals per km^2)	Density Reference(s)[4]
Fraser's dolphin	WNP	220,789	9, 10	0.0040	9, 10
Bottlenose dolphin	WNP	168,791	12	0.0146	12
Pantropical spotted dolphin	WNP	438,064	12	0.0137	12
Striped dolphin	WNP	570,038	12	0.0329	12
Spinner dolphin	WNP	1,015,059	9, 10	0.0005	9, 10
Pacific white-sided dolphin	WNP	931,000	9, 10	0.0119	9, 10
Rough-toothed dolphin	WNP	145,729	9, 10	0.0059	9, 10
Site 3: West Philippine Sea					
Fin whale	NP	9,250	2, 3, 4	0.0002	2, 3, 4
Bryde's whale	WNP	20,501	4	0.0006	3
Minke whale	WNP "O" Stock	25,049	5	0.0033	5
Humpback whale (winter only)	WNP	1,107	16	0.0008	17
Sperm whale	NP	102,112	7	0.0010	8
Kogia spp.	NP	350,553	9	0.0017	10
Cuvier's beaked whale	NP	90,725	10	0.0003	10
Blainville's beaked whale	NP	8,032	9, 10	0.0005	9, 10
Ginkgo-toothed beaked whale	NP	22,799	9, 10	0.0005	9, 10
False killer whale	WNP	16,668	12	0.0029	12
Pygmy killer whale	WNP	30,214	10	0.0021	10
Melon-headed whale	WNP	36,770	9, 10	0.0012	15
Short-finned pilot whale	WNP	53,608	12	0.0076	12
Risso's dolphin	WNP	83,289	12	0.0106	12
Common dolphin	WNP	3,286,163	9, 10	0.0562	9, 10
Fraser's dolphin	WNP	220,789	9, 10	0.0040	9, 10

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (Animals)	Stock / Abundance Reference(s)[4]	Density (Animals per km^2)	Density Reference(s)[4]
Bottlenose dolphin	WNP	168,791	12	0.0146	12
Pantropical spotted dolphin	WNP	438,064	12	0.0137	12
Striped dolphin	WNP	570,038	12	0.0164	12
Spinner dolphin	WNP	1,015,059	9, 10	0.0005	9, 10
Pacific white-sided dolphin	WNP	931,000	9, 10	0.0245	9, 10
Rough-toothed dolphin	WNP	145,729	9, 10	0.0059	9, 10
Site 4: Offshore Guam					
Blue whale	ENP	2,842	18	0.0001	9, 10
Fin whale	ENP	9,250	10	0.0003	10
Sei whale	NP	8,600	1	0.0003	19
Bryde's whale	WNP	20,501	4	0.0004	19
Minke whale	WNP “O” Stock	25,049	5	0.0003	9, 10
Humpback whale (October to May only)	CNP	10,103	16	0.0069	9, 10
Sperm whale	NP	102,112	7	0.0012	19
Kogia spp.	NP	350,553	10	0.0101	15
Cuvier's beaked whale	NP	90,725	10	0.0062	15
Blainville's beaked whale	NP	8,032	10	0.0012	15
Ginkgo-toothed beaked whale	NP	22,799	9, 10	0.0005	9, 10
Longman’s beaked whale	CNP	1,007	15	0.0004	15
Killer whale	CNP	349	15	0.0001	15
False killer whale	WNP	16,668	12	0.0011	19
Pygmy killer whale	WNP	30,214	10	0.0001	19
Melon-headed whale	WNP	36,770	10	0.0043	19

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (animals)	Stock / Abundance Reference(s)[4]	Density (animals per km^2)	Density Reference(s)[4]
Short-finned pilot whale	WNP	53,608	12	0.0016	19
Risso's dolphin	WNP	83289	12	0.0010	15
Common dolphin	WNP	3,286,163	9, 10	0.0021	9, 10
Fraser’s dolphin	CNP	10,226	15	0.0042	15
Bottlenose dolphin	WNP	168,791	12	0.0002	19
Pantropical spotted dolphin	WNP	438,064	12	0.0226	19
Striped dolphin	WNP	570,038	12	0.0062	19
Spinner dolphin	WNP	1,015,059	10	0.0031	19
Rough-toothed dolphin	WNP	145,729	10	0.0003	19
Site 5: Sea of Japan					
Fin whale	NP	9,250	1, 2, 3	0.0009	9, 10
Bryde's whale	WNP	20,501	4	0.0001	10
Minke whale	WNP “O” Stock	25,049	5	0.0004	10
Minke whale	WNP “J” Stock	893	20	0.0002	20
North Pacific right whale (fall to spring)	WNP	922	6	<0.00001	
Gray whale	WNP	121	4	<0.00001	
Sperm whale	NP	102,112	7	0.0008	10
Stejneger's beaked whale	NP	8,000	11	0.0014	10
Baird's beaked whale	WNP	8,000	11	0.0003	9, 10
Cuvier's beaked whale	NP	90,725	10	0.0043	10
Ginkgo-toothed beaked whale	NP	22,799	9, 10	0.0005	9, 10
False killer whale	IA	9,777	12	0.0027	10
Melon-headed whale	WNP	36,770	10	0.00001	10

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

MARINE MAMMAL SPECIES NAME	STOCK NAME[3]	STOCK / ABUNDANCE (ANIMALS)	STOCK / ABUNDANCE REFERENCE(S)[4]	DENSITY (ANIMALS PER KM^2)	DENSITY REFERENCE(S)[4]
Short-finned pilot whale	WNP	53,608	12	0.0014	12
Risso's dolphin	WNP	83,289	12	0.0073	12
Common dolphin	WNP	3,286,163	9, 10	0.0860	9, 10
Bottlenose dolphin	IA	105,138	21	0.0009	10
Pantropical spotted dolphin	WNP	219,032	12	0.0137	12
Spinner dolphin	WNP	1,015,059	9, 10	0.00001	9, 10
Pacific white-sided dolphin	WNP	931,000	9, 10	0.0030	9, 10
Dall's porpoise	SOJ	76,720	10	0.0520	10
SITE 6: EAST CHINA SEA					
Fin whale	ECS	500	1, 2, 3	0.0002	1, 2, 3
Bryde's whale	WNP	20,501	4	0.0006	3
Minke whale	WNP “O” Stock	25,049	5	0.0044	5
Minke whale	WNP “J” Stock	893	20	0.0018	20
North Pacific right whale (winter only)	WNP	922	6	<0.00001	
Gray whale (winter only)	WNP	121	4	<0.00001	
Sperm whale	NP	102,112	7	0.0012	19
Kogia spp.	NP	350,553	9	0.0031	10
Cuvier's beaked whale	NP	90,725	10	0.0062	15
Blainville's beaked whale	NP	8,032	9, 10	0.0012	9, 10
Ginkgo-toothed beaked whale	NP	22,799	9, 10	0.0005	9, 10
False killer whale	IA	9,777	21	0.0011	19
Pygmy killer whale	WNP	30,214	10	0.0001	19
Melon-headed whale	WNP	36,770	10	0.0043	19
Short-finned pilot whale	WNP	53,608	12	0.0016	19

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (Animals)	Stock / Abundance Reference(s)[4]	Density (Animals per km^2)	Density Reference(s)[4]
Risso's dolphin	WNP	83,289	12	0.0106	12
Common dolphin	WNP	3,286,163	9, 10	0.0461	9, 10
Fraser's dolphin	WNP	220,789	9, 10	0.0040	9, 10
Bottlenose dolphin	IA	105,138	21	0.0146	12
Pantropical spotted dolphin	WNP	219,032	12	0.0137	12
Striped dolphin	WNP	570,038	12	0.0164	12
Spinner dolphin	WNP	1,015,059	10	0.0031	19
Pacific white-sided dolphin	WNP	931,000	9, 10	0.0028	9, 10
Rough-toothed dolphin	WNP	145,729	10	0.0059	9, 10
Site 7:South China Sea					
Fin whale	WNP	9,250	1, 2, 3	0.0002	1, 2, 3
Bryde's whale	WNP	20,501	4	0.0006	3
Minke whale	WNP “O” Stock	25,049	5	0.0033	5
North Pacific right whale (winter only)	WNP	922	6	<0.00001	
Gray whale (winter only)	WNP	121	4	<0.0001	
Sperm whale	NP	102,112	7	0.0012	19
Kogia spp.	NP	350,553	9	0.0017	10
Cuvier's beaked whale	NP	90,725	10	0.0003	10
Blainville's beaked whale	NP	8,032	9, 10	0.0005	9, 10
Ginkgo-toothed beaked whale	NP	22,799	9, 10	0.0005	9, 10
False killer whale	IA	9,777	21	0.0011	19
Pygmy killer whale	WNP	30,214	10	0.0001	19
Melon-headed whale	WNP	36,770	10	0.0043	19
Short-finned pilot whale	WNP	53,608	12	0.0016	19

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

MARINE MAMMAL SPECIES NAME	STOCK NAME[3]	STOCK / ABUNDANCE (ANIMALS)	STOCK / ABUNDANCE REFERENCE(S)[4]	DENSITY (ANIMALS PER KM^2)	DENSITY REFERENCE(S)[4]
Risso's dolphin	WNP	83,289	12	0.0106	12
Common dolphin	WNP	3,286,163	9, 10	0.0461	9, 10
Fraser's dolphin	WNP	220,789	9, 10	0.0040	9, 10
Bottlenose dolphin	IA	105,138	21	0.0146	12
Pantropical spotted dolphin	WNP	219,032	12	0.0137	12
Striped dolphin	WNP	570,038	12	0.0164	12
Spinner dolphin	WNP	1,015,059	10	0.3140	19
Rough-toothed dolphin	WNP	145,729	9, 10	0.0040	9, 10
SITE 8: OFFSHORE JAPAN (25º to 40ºN)					
Blue whale	NP	9,250	1	0.0003	1
Fin whale	NP	9,250	1, 2, 3	0.0001	1, 2, 3
Sei whale	NP	37,000	3	0.0003	19
Bryde's whale	WNP	20,501	4	0.0004	19
Minke whale	WNP “O” Stock	25,049	5	0.0003	5
Sperm whale	NP	102,112	7	0.0003	9, 10
Kogia spp.	NP	350,553	9	0.0049	10
Baird's beaked whale	WNP	8,000	11	0.0001	11
Cuvier's beaked whale	NP	90,725	10	0.0017	10
Mesoplodon spp.	NP	22,799	9, 10	0.0005	9, 10
False killer whale	WNP	16,668	12	0.0036	12
Pygmy killer whale	WNP	30,214	10	0.0001	19
Melon-headed whale	WNP	36,770	10	0.0012	15
Short-finned pilot whale	WNP	53,608	12	0.0001	10
Risso's dolphin	WNP	83,289	12	0.0010	10

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

MARINE MAMMAL SPECIES NAME	STOCK NAME[3]	STOCK / ABUNDANCE (ANIMALS)	STOCK / ABUNDANCE REFERENCE(S)[4]	DENSITY (ANIMALS PER KM^2)	DENSITY REFERENCE(S)[4]
Common dolphin	WNP	3,286,163	9, 10	0.0863	9, 10
Bottlenose dolphin	WNP	168,791	12	0.0005	10
Pantropical spotted dolphin	WNP	438,064	12	0.0181	9, 10
Striped dolphin	WNP	570,038	12	0.0500	9, 10
Spinner dolphin	WNP	1,015,059	9, 10	0.00001	9, 10
Pacific white-sided dolphin	WNP	67,769	9, 10	0.0048	9, 10
Rough-toothed dolphin	WNP	145,729	9, 10	0.0003	19
Hawaiian monk seal	Hawaii	1,129	18	<0.00001	
SITE 9: OFFSHORE JAPAN (10° TO 25°N)					
Bryde's whale	WNP	20,501	4	0.0004	19
Sperm whale	NP	102,112	22	0.0004	9, 10
Kogia spp.	NP	350,553	9	0.0009	10
Cuvier's beaked whale	NP	90,725	10	0.0017	10
False killer whale	WNP	16,668	12	0.0021	12
Melon-headed whale	WNP	36,770	10	0.0012	15
Short-finned pilot whale	WNP	53,608	12	0.0009	10
Risso's dolphin	WNP	83,289	12	0.0026	10
Common dolphin	WNP	3,286,163	9, 10	0.0863	9, 10
Bottlenose dolphin	WNP	168,791	12	0.0007	10
Pantropical spotted dolphin	WNP	438,064	12	0.0226	19
Striped dolphin	WNP	570,038	12	0.0110	12
Spinner dolphin	WNP	1,015,059	10	0.0031	19
Rough-toothed dolphin	WNP	145,729	9, 10	0.0003	19
SITE 10: HAWAII NORTH					

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

MARINE MAMMAL SPECIES NAME	STOCK NAME[3]	STOCK / ABUNDANCE (ANIMALS)	STOCK / ABUNDANCE REFERENCE(S)[4]	DENSITY (ANIMALS PER KM^2)	DENSITY REFERENCE(S)[4]
Blue whale	WNP	1,548	17	0.0002	9, 10
Fin whale	Hawaii	2,099	17	0.0007	9, 10
Bryde's whale	Hawaii	469	15	0.0002	15
Minke whale	WNP	25,000	5	0.0002	9, 10
Humpback whale (summer)	Hawaii	10,103	16	<0.0001	15
Sperm whale	CNP	6,919	15	0.0028	15
Kogia spp	Hawaii	24,657	15	0.0101	15
Cuvier's beaked whale	Hawaii	15,242	15	0.0062	15
Blainville's beaked whale	Hawaii	2,872	15	0.0012	15
Longman's beaked whale	Hawaii	1,007	15	0.0004	15
Killer whale	Hawaii	349	15	0.0001	15
False killer whale	Hawaii Pelagic	484	61	0.0002	61
Pygmy killer whale	Hawaii	956	15	0.0004	15
Melon-headed whale	Hawaii	2,950	15	0.0012	15
Short-finned pilot whale	Hawaii	8,870	15	0.0036	15
Risso's dolphin	Hawaii	2,372	15	0.0010	15
Fraser's dolphin	Hawaii	10,226	15	0.0042	15
Bottlenose dolphin	Hawaii	3,215	15	0.0013	15
Pantropical spotted dolphin	Hawaii	8,978	15	0.0037	15
Striped dolphin	Hawaii	13,143	15	0.0054	15
Spinner dolphin	Hawaii	3,351	15	0.0014	15
Rough-toothed dolphin	Hawaii	8,709	15	0.0036	15
Hawaiian monk seal	Hawaii	1,129	18	<0.0001	
SITE 11: HAWAII SOUTH					

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (animals)	Stock / Abundance Reference(s)[4]	Density (animals per km^2)	Density Reference(s)[4]
Blue whale	WNP	1,548	17	0.0002	9, 10
Fin whale	Hawaii	2,099	17	0.0007	9, 10
Bryde's whale	Hawaii	469	15	0.0002	15
Minke whale	Hawaii	25,000	5	0.0002	9, 10
Humpback whale (fall through spring)	Hawaii	10,103	16	0.0008	17
Sperm whale	CNP	6,919	15	0.0028	15
Kogia spp.	Hawaii	24,657	15	0.0101	15
Cuvier's beaked whale	Hawaii	15,242	15	0.0062	15
Blainville's beaked whale	Hawaii	2,872	15	0.0012	15
Longman's beaked whale	Hawaii	1,007	15	0.0004	15
Killer whale	Hawaii	349	15	0.0001	15
False killer whale	Hawaii Pelagic	484	61	0.0002	61
Pygmy killer whale	Hawaii	956	15	0.0004	15
Melon-headed whale	Hawaii	2,950	15	0.0012	15
Short-finned pilot whale	Hawaii	8,870	15	0.0036	15
Risso's dolphin	Hawaii	2,372	15	0.0010	15
Fraser's dolphin	Hawaii	10,226	15	0.0042	15
Bottlenose dolphin	Hawaii	3,215	15	0.0013	15
Pantropical spotted dolphin	Hawaii	8,978	15	0.0037	15
Striped dolphin	Hawaii	13,143	15	0.0054	15
Spinner dolphin	Hawaii	3,351	15	0.0014	15
Rough-toothed dolphin	Hawaii	8,709	15	0.0036	15
Hawaiian monk seal	Hawaii	1,129	18	<0.0001	
Site 12: Offshore Southern California (in SOCAL OPAREA)					

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

MARINE MAMMAL SPECIES NAME	STOCK NAME[3]	STOCK / ABUNDANCE (ANIMALS)	STOCK / ABUNDANCE REFERENCE(S)[4]	DENSITY (ANIMALS PER KM^2)	DENSITY REFERENCE(S)[4]
Blue whale	ENP	2,842	18	0.0014	17
Fin whale	CA/OR/WA	2,099	17	0.0018	17
Sei whale	ENP	98	17	0.0001	17
Bryde’s whale	ENP	13,000	24	0.00001	24
Northern minke whale	CA/OR/WA	823	17	0.0007	17
Humpback whale	CA/OR/WA	942	17	0.0008	17
Gray whale	ENP	18,813	14	0.051	25
Sperm whale	CA/OR/WA	1,934	17	0.0017	17
Pygmy sperm whale	CA/OR/WA	1,237	17	0.0011	17
Stejneger's beaked whale	CA/OR/WA	1,177	17	0.0010	17
Baird’s beaked whale	CA/OR/WA	1,005	17	0.0009	17
Cuvier's beaked whale	CA/OR/WA	4,342	17	0.0038	17
Blainville's beaked whale	CA/OR/WA	1,177	17	0.0010	17
Ginkgo-toothed beaked whale	CA/OR/WA	1,177	17	0.0010	17
Hubb’s beaked whale	CA/OR/WA	1,177	17	0.0010	17
Longman’s beaked whale	Hawaii	1,177	17	0.0010	17
Perrin's beaked whale	CA/OR/WA	1,177	17	0.0010	17
Pygmy beaked whale	CA/OR/WA	1,177	17	0.0010	17
Killer whale	ENP Offshore	810	17	0.0007	17
Short-finned pilot whale	CA/OR/WA	350	17	0.0003	17
Risso’s dolphin	CA/OR/WA	11,910	17	0.0105	17
Long-beaked common dolphin	CA/OR/WA	21,902	17	0.0192	17
Short-beaked common dolphin	CA/OR/WA	352,069	17	0.3094	17

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (Animals)	Stock / Abundance Reference(s)[4]	Density (Animals per km^2)	Density Reference(s)[4]
Bottlenose dolphin	CA/OR/WA offshore	2,026	17	0.0018	17
Striped dolphin	CA/OR/WA	18,976	17	0.0167	17
Pacific white-sided dolphin	CA/OR/WA	23,817	17	0.0209	17
Northern right whale dolphin	CA/OR/WA	11,097	17	0.0098	17
Dall's porpoise	CA/OR/WA	85,955	17	0.0753	17
Guadalupe fur seal	Mexico	7,408	18	0.007	25
Northern fur seal	San Miguel Island	9,424	18	0	25
California sea lion (on shelf)	California	238,000	18	0.54	25
California sea lion (offshore)	California	238,000	18	0	25
Harbor seal	California	34,233	18	0.0095	25
Northern elephant seal (on shelf)	California Breeding	124,000	18	0.0045	25
Northern elephant seal (offshore)	California Breeding	124,000	18	0	25
Site 13: Northwestern Atlantic off Florida (in JAX OPAREA)					
Humpback whale	WNA	11,570	27	0.0006	26
North Atlantic right whale (on shelf; winter to spring only)	WNA	438	28	0.0012	26
Sperm whale (on shelf)	WNA	4,804	29	0	26
Sperm whale (off shelf)	WNA	4,804	29	0.0005	26
Kogia spp.	WNA	580	30	0.0010	26
Beaked whales (on shelf)	WNA	3,513	29	0	26
Beaked whales (off shelf)	WNA	3,513	29	0.0006	26

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (Animals)	Stock / Abundance Reference(s)[4]	Density (Animals per km^2)	Density Reference(s)[4]
Cuvier's beaked whale	WNA	3,513	29	0.0006	26
Blainville's beaked whale	WNA	3,513	29	0.0006	26
Gervais' beaked whale	WNA	3,513	29	0.0006	26
Sowerby's beaked whale	WNA	3,513	29	0.0006	26
True's beaked whale	WNA	3,513	29	0.0006	26
Short-finned pilot whale (on shelf)	WNA	31,139	29	0.00004	26
Short-finned pilot whale (off shelf)	WNA	31,139	29	0.0271	26
Risso's dolphin (on shelf)	WNA	20,479	29	0.0009	26
Risso's dolphin (off shelf)	WNA	20,479	29	0.0181	26
Common dolphin	WNA	120,743	29	0.00002	26
Bottlenose dolphin (on shelf)	WNA	81,588	29	0.2132	26
Bottlenose dolphin (off shelf)	WNA	81,588	29	0.1163	26
Pantropical spotted dolphin	WNA	12,747	30	0.0223	26
Striped dolphin	WNA	94,462	29	0.00003	26
Atlantic spotted dolphin (on shelf)	WNA	50,978	29	0.4435	26
Atlantic spotted dolphin (off shelf)	WNA	50,978	29	0.0041	26
Clymene dolphin	WNA	6,086	29	0.0106	26
Rough-toothed dolphin	WNA	274	30	0.0005	26
Site 14: Northeastern Atlantic off United Kingdom					
Blue whale	ENA	100	31, 32	0.00001	32
Fin whale	ENA	10,369	32	0.0031	32
Sei whale	ENA	14,152	33, 34	0.0113	33
Northern minke whale	ENA	107,205	35	0.0068	36
Humpback whale	ENA	4,695	32	0.0019	32

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

MARINE MAMMAL SPECIES NAME	STOCK NAME[3]	STOCK / ABUNDANCE (ANIMALS)	STOCK / ABUNDANCE REFERENCE(S)[4]	DENSITY (ANIMALS PER KM^2)	DENSITY REFERENCE(S)[4]
Sperm whale	ENA	6,375	32	0.0049	32
Kogia spp.	ENA	580	30	0.0001	30
Cuvier's beaked whale	ENA	3,513	29	0.0013	26
Blainville's beaked whale	ENA	3,513	29	0.0013	26
Sowerby's beaked whale	ENA	3,513	29	0.0013	26
Northern bottlenose whale	ENA	5,827	38	0.0003	37
Killer whale	ENA	6,618	38	0.0001	37
False killer whale	ENA	484	18	0.0001	37
Long-finned pilot whale	ENA	778,000	39	0.0121	26
Risso's dolphin	ENA	20,479	29	0.0063	26
Common dolphin	ENA	273,150	40	0.238	31
Bottlenose dolphin	ENA	81,588	29	0.0094	26
Striped dolphin	ENA	94,462	29	0.0765	26
Atlantic white-sided dolphin	ENA	11,760	36	0.0027	36
White-beaked dolphin	ENA	11,760	36	0.0027	36
Harbor porpoise	ENA	341,366	36	0.2299	36
Harbor seal	Ireland / Scotland	23,500	41	0.0230	26
Gray seal	ENA	113,300	42	0.027	26
SITE 15: WESTERN MEDITERRANEAN SEA—LIGURIAN SEA					
Fin whale	MED	3,583	44	0.004	43, 44, 45
Sperm whale	WMED	6,375	32	0.0049	32
Cuvier's beaked whale	ENA	3,513	29	0.0013	26
Long-finned pilot whale	ENA	778,000	39	0.0121	26
Risso's dolphin	WMED	5,320	46, 47	0.0075	46

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (animals)	Stock / Abundance Reference(s)[4]	Density (animals per km^2)	Density Reference(s)[4]
Common dolphin	WMED	19,428	48	0.0144	48
Bottlenose dolphin	WMED	23,304	46, 49, 50	0.041	46
Striped dolphin	WMED	117,880	51	0.24	51
Site 16: Northern Arabian Sea					
Bryde's whale	IND	9,176	24	0.0001	52, 53
Humpback whale	XAR	200	54, 55, 56	0.0004	9, 10
Sperm whale	IND	24,446	24	0.0125	52, 53
Dwarf sperm whale	IND	10,541	24	0.0145	52, 53
Cuvier's beaked whale	IND	27,272	24	0.0001	52, 53
Blainville's beaked whale	IND	16,867	24	0.0016	52, 53
Gingko-toothed beaked whale	IND	16,867	24	0.0016	52, 53
Longman's beaked whale	IND	16,867	24	0.0016	52, 53
False killer whale	IND	144,188	24	0.0003	52, 53
Pygmy killer whale	IND	22,029	24	0.0026	52, 53
Melon-headed whale	IND	64,600	24	0.0661	52, 53
Short-finned pilot whale	IND	268,751	24	0.0034	52, 53
Risso's dolphin	IND	452,125	24	0.0125	52, 53
Common dolphin	IND	1,819,882	24	0.0265	52, 53
Bottlenose dolphin	IND	785,585	24	0.0164	52, 53
Pantropical spotted dolphin	IND	736,575	24	0.0127	52, 53
Striped dolphin	IND	674,578	24	0.0706	52, 53
Spinner dolphin	IND	634,108	24	0.01	52, 53
Rough-toothed dolphin	IND	156,690	24	0.0081	52, 53
Site 17: Andaman Sea (off Myanmar)					

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (animals)	Stock / Abundance Reference(s)[4]	Density (animals per km^2)	Density Reference(s)[4]
Bryde's whale	IND	9,176	24	0.0001	52, 53
Sperm whale	IND	24,446	24	0.0125	52, 53
Dwarf sperm whale	IND	10,541	24	0.0145	52, 53
Cuvier's beaked whale	IND	27,272	24	0.0001	52, 53
Blainville's beaked whale	IND	16,867	24	0.0016	52, 53
Gingko-toothed beaked whale	IND	16,867	24	0.0016	52, 53
Longman's beaked whale	IND	16,867	24	0.0016	52, 53
Killer whale	IND	12,593	24	0.0001	52, 53
False killer whale	IND	144,188	24	0.0003	52, 53
Pygmy killer whale	IND	22,029	24	0.0026	52, 53
Melon-headed whale	IND	64,600	24	0.0661	52, 53
Short-finned pilot whale	IND	268,751	24	0.0034	52, 53
Risso's dolphin	IND	452,125	24	0.0125	52, 53
Common dolphin	IND	1,819,882	24	0.0265	52, 53
Bottlenose dolphin	IND	785,585	24	0.0164	52, 53
Pantropical spotted dolphin	IND	736,575	24	0.0127	52, 53
Striped dolphin	IND	674,578	24	0.0706	52, 53
Spinner dolphin	IND	634,108	24	0.01	52, 53
Rough-toothed dolphin	IND	156,690	24	0.0081	52, 53
Site 18: Panama Canal—West Approach					
Blue whale	ENP	2,842	18	0.0001	9, 10
Bryde's whale	ETP	13,000	24	0.0003	9, 10
Humpback whale	ENP	1,391	18	0.0004	9, 10
Sperm whale	ETP	22,700	24	0.0047	9, 10

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (animals)	Stock / Abundance Reference(s)[4]	Density (animals per km^2)	Density Reference(s)[4]
Dwarf sperm whale	ETP	11,200	24	0.0145	9, 10
Cuvier's beaked whale	ETP	20,000	24	0.0025	9, 10
Blainville's beaked whale	ETP	25,300	24	0.0013	9, 10
Gingko-toothed beaked whale	ETP	25,300	24	0.0016	9, 10
Longman's beaked whale	ETP	25,300	24	0.0003	9, 10
Pygmy beaked whale	ETP	25,300	24	0.0016	9, 10
Killer whale	ETP	8,500	24	0.0002	9, 10
False killer whale	ETP	39,800	24	0.0004	9, 10
Pygmy killer whale	ETP	38,900	24	0.0014	9, 10
Melon-headed whale	ETP	45,400	24	0.0174	9, 10
Short-finned pilot whale	ETP	160,200	24	0.0058	9, 10
Risso's dolphin	ETP	110,457	57	0.0161	9, 10
Common dolphin	ETP	3,127,203	57	0.049	9, 10
Fraser's dolphin	ETP	289,300	24	0.001	9, 10
Bottlenose dolphin	ETP	335,834	57	0.0157	9, 10
Pantropical spotted dolphin	NEOP	640,000	58	0.0669	9, 10
Striped dolphin	ETP	964,362	57	0.1199	9, 10
Spinner dolphin	Eastern	450,000	58	0.007	9, 10
Rough-toothed dolphin	ETP	107,633	57	0.0146	9, 10
Site 19: Northeastern Australia Coast					
Blue whale	WSP	9,250	1, 2, 3	0.0002	1, 2, 3
Fin whale	WSP	9,250	1, 2, 3	0.0002	1, 2, 3
Bryde's whale	WSP	22,000	4	0.0006	3
Northern minke whale	WSP	25,000	5	0.0044	5

Table C-1. Marine mammal species and stocks, abundance estimates, density estimates, as well as associated references for each SURTASS LFA sonar operating area.

Marine Mammal Species Name	Stock Name[3]	Stock / Abundance (animals)	Stock / Abundance Reference(s)[4]	Density (animals per km^2)	Density Reference(s)[4]
Humpback whale	GVEA	3,500	59	0.0143	59
Sperm whale	WSP	102,112	14	0.0029	14
Kogia spp.	WSP	350,553	9, 10	0.0031	9, 10
Cuvier's beaked whale	WSP	90,725	10	0.0054	10
Blainville's beaked whale	WSP	8,032	9, 10	0.0005	9, 10
Amoux's beaked whale	WSP	22,799	9, 10	0.0005	9, 10
Gingko-toothed beaked whale	WSP	22,799	9, 10	0.0005	9, 10
Longman's beaked whale	WSP	22,799	9, 10	0.0005	9, 10
Southern bottlenose whale	WSP	22,799	9, 10	0.0005	9, 10
Killer whale	WSP	12,256	9, 10	0.0004	9, 10
False killer whale	WSP	16,668	12	0.0029	12
Pygmy killer whale	WSP	30,214	10	0.0021	10
Melon-headed whale	WSP	36,770	9, 10	0.0012	15
Globicephala spp.	WSP	53,608	12	0.0153	12
Risso's dolphin	WSP	83,289	12	0.0106	12
Common dolphin	WSP	3,286,163	9, 10	0.0562	9, 10
Fraser's dolphin	WSP	220,789	9, 10	0.004	9, 10
Bottlenose dolphin	WSP	168,791	12	0.0146	12
Pantropical spotted dolphin	WSP	438,064	12	0.0137	12
Striped dolphin	WSP	570,038	12	0.0329	12
Spinner dolphin	WSP	1,015,059	9, 10	0.0005	9, 10
Dusky dolphin	WSP	12,626	60	0.0002	9, 10
Rough-toothed dolphin	WSP	145,729	9, 10	0.0059	9, 10

APPENDIX TABLE C-1 LITERATURE CITED[5]

1. Tillman, 1977
2. Masaki, 1977
3. Ohsumi, 1977
4. IWC, 2009
5. Buckland et al., 1992
6. Best et al., 2001
7. Kato and Miyashita, 1998
8. Mobley et al., 2000
9. Ferguson and Barlow, 2001
10. Ferguson and Barlow, 2003
11. Kasuya, 1986
12. Miyashita, 1993
13. Buckland et al., 1993
14. Allen and Angliss, 2010
15. Barlow, 2006
16. Calamboikidis et al., 2008
17. Barlow and Forney, 2007
18. Caretta et al. 2010
19. DoN, 2007a
20. Pastene and Goto, 1998
21. Miyashita, 1986
22. Kasuya and Miyashita, 1988
24. Wade and Gerrodette, 1993
25. DoN, 2008
26. DoN, 2007b
27. Stevick et al., 2003
28. NARWC, 2009
29. Waring et al., 2009
30. Mullin and Fulling, 2003
31. Waring et al., 2008
32. Øien, 2008
33. Macleod et al., 2006
34. Heide-Jørgensen et al., 2007
35. Skaug et al., 2004
36. Hammond et al., 2002
37. Barlow et al., 2006
38. Gunnlaugsson and Sigurjónsson, 1990
39. Buckland et al., 1993
40. Cañadas et al., 2004
41. North Atlantic Marine Mammal Commission, 2006
42. Gerondeau et al., 2007
43. Forcada et al., 1995
44. Forcada et al., 1996
45. Gannier, 1997
46. Gómez de Segura et al., 2006
47. Airoldi et al., 2005
48. Cañadas, 2006
49. Forcada et al., 2004
50. Cañadas and Hammond, 2006
51. Forcada and Hammon, 1998
52. Ballance and Pitman, 1998
53. Dolar et al., 2006
54. Rosenbaum et al., 2009
55. Minton et al., 2008
56. Minton et al., In Press
57. Gerrodette et al., 2008
58. Gerrodette and Forcada, 2005
59. Department of the Environment and Heritage, 2005
60. Markowitz, 2004
61. Barlow and Rankin, 2007

[5] Full citations for the literature listed here may be found at the end of Appendix C in the Literature Cited section.

C-2.3 AIM Modeling for SURTASS LFA SEIS/SOEIS

The simulation areas for acoustic impact analysis were the potentially ensonified areas of the 19 proposed SURTASS LFA sonar operating areas (Table C-2). Each marine mammal species potentially found in these areas was simulated by creating animats programmed with behavioral values describing their dive behavior; including dive depth, surfacing time, dive duration, swimming speed, and course change.

Table C-2. Locations of the 19 potential SURTASS LFA sonar operating areas (OPAREAs).

OPAREA	SITE NAME	SEASON	LOCATION	REMARKS
1	East of Japan	Summer	38°N/148°E	
2	North Philippine Sea	Fall	29°N/136°E	
3	West Philippine Sea	Fall	22°N/124°E	
4	Guam	Sum/Fall	11°N/145°E	Mariana Islands Range Complex (outside Mariana Trench)
5	Sea of Japan	Fall	39°N/132°E	
6	East China Sea	Summer	26°N/125°E	
7	South China Sea	Fall	21°N/119°E	
8	NW Pacific 25° to 40°N	Summer	30°N/165°E	
9	NW Pacific 10° to 25°N	Winter	15°N/165°E	
10	Hawaii North	Summer	25°N/158°W	Hawaii Range Complex
11	Hawaii South	Spring/Fall	19.5°N/158.5°W	Hawaii Range Complex
12	Offshore Southern California	Spring	32°N/120°W	SOCAL Range Complex
13	Western Atlantic (off Florida)	Winter	30°N/78°W	AFAST Study Area (Jacksonville OPAREA)
14	Eastern North Atlantic	Summer	56.5N/10W	NW Approaches
15	Mediterranean Sea–Ligurian Sea	Summer	43°N/8°E	
16	Arabian Sea	Summer	20°N/65°E	
17	Andaman Sea	Summer	7.5°N/96°E	Approaches to Strait of Malacca
18	Panama Canal	Winter	5°N/81°W	Western Approach
19	NE Australian Coast	Spring	23°S/155°E	

After the animats were created, they were randomly distributed over the simulation area. The simulation area was determined by first finding the range at which the transmission loss was at least 100 dB (more details follow). The time step used for modeling was 30 sec and the modeling animat density was 0.1 or 0.05 animats/km^2, which is higher than that expected in the actual environment. This “over-population” ensures that the result of the simulation is not unduly influenced by the chance placement of a few animals.. To obtain final harassment estimates, the results are normalized by the ratio of the modeled animat density to the real-world animal population density estimate. This allows for greater statistical power without overestimating risk.

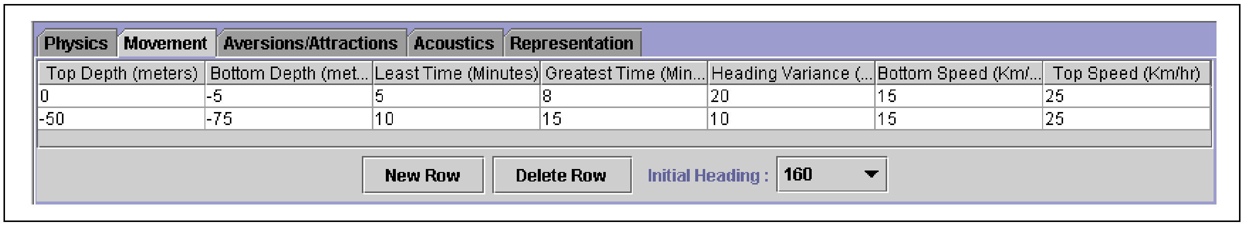
During the AIM modeling, the animats were programmed to remain within the analysis area, and they “reflected” off the boundaries of the AIM analysis area. This reflection represented one animat entering the analysis area for each animat leaving the area—hence, a net change in the number of animats in the analysis area was zero and no animats diffused out of the analysis area. For a nominal AIM model run of approximately seven (7) days, it has been the Navy’s experience that only about 2 to 10% of the modeled animats encounter the analysis area boundary. Additionally, due to the distance from the model area boundary to the source at the box’s center (0 to 150 nmi), it is only a very small percentage (typically less than 0.1% of all modeled animats) that ever approach within 10 nmi of the source while it is transmitting, within the seven modeled days.

C-2.3.1 ANIMAT MOVEMENT IN AIM

Animals move through four dimensions: three spatial dimensions and time. One of the outputs of AIM is a report of the four-dimensional movement of an animat. Several parameters are used in AIM to produce simulated movement that accurately represents expected real animal movement patterns. The following sections are short discussions of the various parameters and their implementation.

C-2.3.1.1 Diving Patterns

A typical dive pattern for a marine mammal consists of at least two phases; a shallow respiratory sequence that is followed by a deeper, longer dive. Diving parameters, such as time limits, depth limits, heading variance, and speed, are specified for each animat in the AIM model (Figure C-1). The first row shows the parameter values for shallow, respiratory dives. In this case, the parameters specify that an animal dives from the surface to a maximum depth of 5 m for at least 5 min and up to 8 min. The second row describes the second phase of the dive; in this phase the animal dives to a depth between 50 and 75 m for at least 10 min and up to 15 min. The horizontal component of the dive is handled with the “heading variance” term; it allows the animal to change course up to a certain number of degrees at each movement step. In this case, the animal can change course 20° during the shallow dive, but only 10° during the deep dive. This example is for a narrowly constrained set of variables, appropriate for a migratory animal. Using these diving parameters, AIM generates realistic dive patterns (Figure C-2). The dive parameters listed in Figure C-3, produced the sample dive pattern shown here. The animat dives from the surface to a maximum depth of 5 m for approximately 6 min before resurfacing. The animat then performs a deep dive to 60 m for about 5 min, changes depth to 50 m for another 5 min, and then surfaces



Top Depth (meters)	Bottom Depth (met...	Least Time (Minutes)	Greatest Time (Min...	Heading Variance (...	Bottom Speed (Km/...	Top Speed (Km/hr)
0	-5	5	8	20	15	25
-50	-75	10	15	10	15	25

Figure C-1. Example of marine mammal dive parameters.

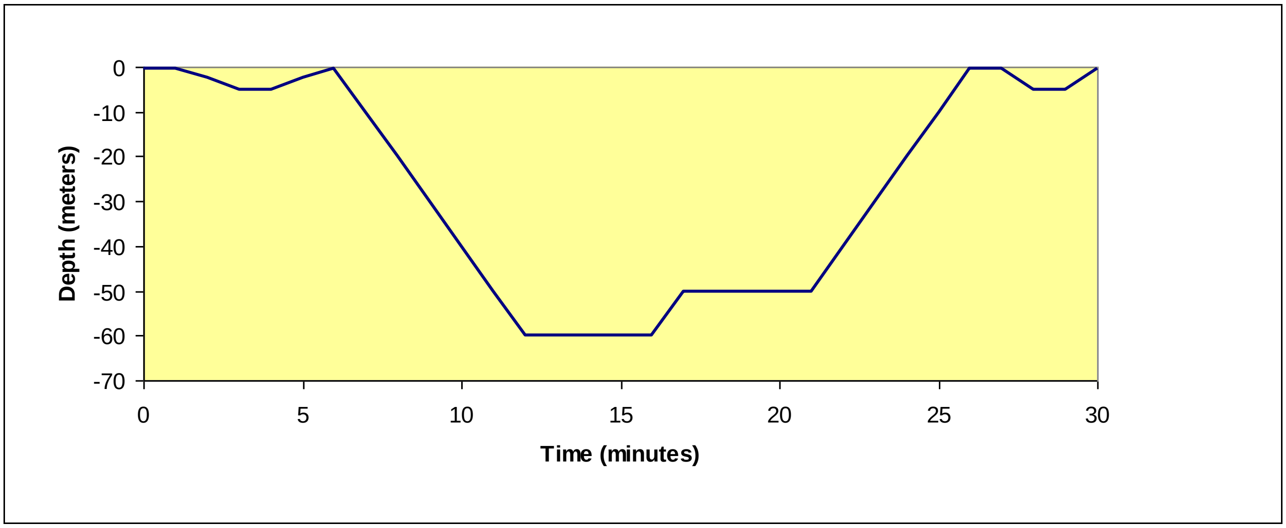
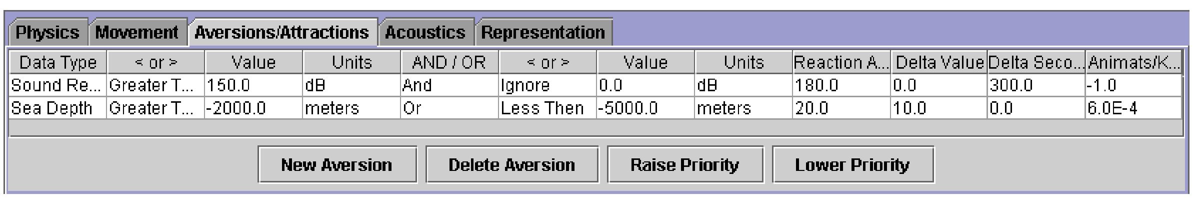


Figure C-2. Example of marine mammal dive pattern.



Data Type	< or >	Value	Units	AND / OR	< or >	Value	Units	Reaction A...	Delta Value	Delta Seco...	Animats/K...
Sound Re...	Greater T...	150.0	dB	And	Ignore	0.0	dB	180.0	0.0	300.0	-1.0
Sea Depth	Greater T...	-2000.0	meters	Or	Less Then	-5000.0	meters	20.0	10.0	0.0	6.0E-4

Figure C-3. Example of depth aversion parameters for marine mammal movement modeling.

C-2.3.1.2 Aversions

In addition to movement patterns, the animats can be programmed to avoid certain environmental characteristics. For example, aversions can be used to constrain an animal to a particular depth regime (e.g., an animat can be constrained to waters between 2,000 and 5,000 m deep). The second row specifies that the animat reacts by making a series of 20° turns if it is in waters that are shallower than 2,000 m or deeper than 5,000 m. The animat will continue to turn until the aversion is satisfied.

C-2.3.2 Animal Behavior Parameters Used in AIM Modeling

MAI maintains a database of animal behavior parameters to be used in AIM modeling. Dive parameters that were used in the modeling are discussed and listed for available species (Table C-3). Little or no data are available to specify movement and aversion values for some marine mammal species. For this reason, some species are grouped with their closest taxonomic relatives for modeling purposes. When species are grouped, the rationale is given in the introduction to that group. Dive details for individual species are provided, including the reference information and logic used to select each of the parameters.

C-2.3.2.1 Blue Whale (*Balaenoptera musculus*)

Surface Time

Of four satellite-tagged blue whales, data reported for one whale's surface intervals was 7 to 90 sec, with a mean of 48 sec. No surface intervals >60 sec were reported for the other three whales, indicating that the surface time was short (Lagerquist et al., 2000).

Dive Depth

Croll et al. (2001a) reported a mean dive depth of 140 m (± 46.01) for non-foraging animals, while foraging whales had a mean dive depth of 67.6 m (± 51.46). Satellite-tagged whales off California had a maximum dive depth of 192 m (Lagerquist et al., 2000). The distribution of dive depths was bimodal (Figure C-4) (note that this is from one animal). Therefore, the blue whale will be programmed with most of its dives to shallow water depth, with a lower percentage of deep dives.

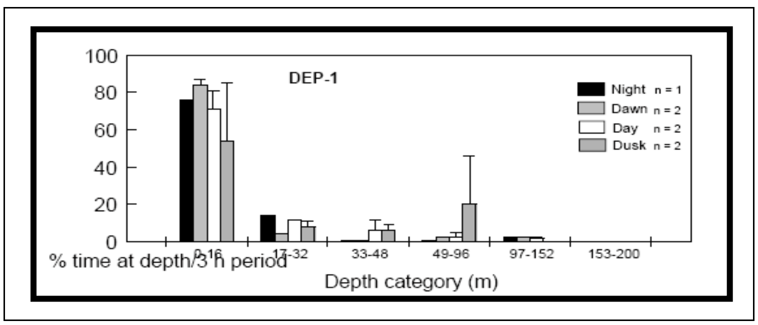


Figure C-4. Blue whale dive depth distribution (for one whale) showing bimodal distribution.

Dive Time

Mean dive times of 4.3, 7.8, 4.9 5.7, 10.0, and 7.0 min have been reported for blue whales (Laurie, 1933; Doi 1974; Lockyer, 1976; Croll et al., 1998; Croll et al., 2001a). The best estimate of the maximum dive time is 14.7 min (Croll et al., 2001a), although a maximum time of 30 min was reported by Laurie (1933) The longest dive reported for satellite-tagged whales was 18 min, although the mean dive times for all whales was 5.8 (±1.5) min (Lagerquist et al., 2000)

Speed

Dive descent rates of 1.26 m/sec have been recorded (Williams et al., 2000). A mean surface speed of 1.25 m/sec with a maximum speed of 2.0 m/sec was reported from satellite tags (Mate et al., 1999), although satellite data tend to smooth the track and therefore underestimate speed. A second satellite tag study found straight-line speed under estimates from 1.3 to 14.2 km/hr.

Group Size

Blue whales in the Eastern Tropical Pacific had a modal group size of one, although pods of two were somewhat common (Reilly and Thayer, 1990). The mean group size of blue whales off Australia (*B. m. brevicauda*) was 1.55 animals (Gill, 2002).

Table C-3. Dive parameters of the marine mammal species modeled for risk assessment to acoustic exposure.

Modeled Species	Min/Max Surface Time (min)	Surface / Dive Angle	Dive Depth (m) Min/Max (Percentage)	Min/ Max Dive Time (min)	Heading Variance (angle / time)	Min /Max Speed (km/hr)	Speed distribution	Depth limit (m) / reaction angle
Blue Whale (non-foraging)	1/2		40/192	2/18	30	3/14	Normal	100/ reflect
Blue Whale (foraging)	1/2		10/20 (70) 20/160 (30)	2/18 4/18	30	3/14	Normal	100/ reflect
Fin Whale	1/1		20/250 (90) 250/470 (10)	5/8 1/20	20	1/16	Normal	30/ reflect
Sei/Bryde's Whale	1/1	90/75	20/150	2/11	30	0/20	5/1	50/ reflect
Minke Whale	1/3		20/100	2/6	Surf 45, Dive 20	1/18	Gamma (3.25,2)	10 / reflect
Humpback Whale (migrating)	1/2		10/40 (100)	5/10	10	2/10	Normal	(Min =100) / reflect
Humpback Whale (feeding)	1/2		10/40 (75) 40/100 (20) 100/150 (5)	5/10	45/30	2/10	Normal	(Min =100) / reflect
Humpback Whale (winter grounds, singing)	1/1		10/25 (100)	5/25	20	0/1	Normal	>1000/ reflect
Humpback Whale (calf)	1/2		5/30 (100)	2/5	45	1/3	Normal	>200/ reflect
Humpback Whale (winter grounds and migrating adults)	1/1		10/50	5/20	20	1/6	Gamma	1000/ reflect
Right Whale	4/5		113/130	11/13	30	3/6	Normal	
Gray Whale (migrating)	1/2		10/40	3/12	10	2/9	Normal	10/ reflect
Gray Whale (summering)	1/2		10 / bottom	1/7	45	1/5	Normal	
Sperm Whale	8/11	90/75	600/1400 (90), 200/600 (10)	18/65	20	0.1 / 10	Normal	200/ reflect

Table C-3. Dive parameters of the marine mammal species modeled for risk assessment to acoustic exposure.

MODELED SPECIES	MIN/MAX SURFACE TIME (MIN)	SURFACE / DIVE ANGLE	DIVE DEPTH (M) MIN/MAX (PERCENTAGE)	MIN/ MAX DIVE TIME (MIN)	HEADING VARIANCE (ANGLE / TIME)	MIN /MAX SPEED (KM/HR)	SPEED DISTRIBUTION	DEPTH LIMIT (M) / REACTION ANGLE
Kogia species.	1/2		200/1000	5/12	30	0/11	Normal	117/ reflect
Beaked Whales	1/7		1000/1453 (90), 50/200 (10)	12/70	30	3/6	Normal	253/ reflect
Killer Whale	1/1		10/180	1/10	30	3/12	Normal	25/ reflect
False/Pygmy Killer whales	1/1		5/50 (80) 50/100 (20)	2/12	30	2/22.4	Gamma.	200/ reflect
Pilot Whales	1/1		5/50 (80) 50/1000 (20)	2/12	30	2/12	Gamma.	200/ reflect
Risso's Dolphin	1/3		150/1000	2/12	30	2/12	Normal	150/ reflect
Common Dolphin	1/1		50/200	1/5	30	2/9	Normal	100-1000/ reflect
Fraser’s Dolphin	1/1		10/700	1/6	30	2/9	Normal	100/ reflect
Bottlenose Dolphin (Coastal)	1/1		15/98	1/3	30	2/16	Normal	10/ reflect
Bottlenose Dolphin (Pelagic)	1/1		15/200	1/3	30	2/16	Normal	101/ 1226 reflect
Stenella species	1/1		Day: 5/25 (50) Night: 10/400 (10) Night: 10/100 (40)	1/4	30	2/9	Normal	10/ reflect
Lagenorhynchus species	1/1		25/125	1/3	30	2/9	Normal	
Rough-toothed Dolphin	1/3		50/600	3/5	30	5/16	Normal	194/ reflect
Right Whale Dolphin	1/1			1/6	30	0/5 and 20/35	Normal	

Table C-3. Dive parameters of the marine mammal species modeled for risk assessment to acoustic exposure.

Modeled Species	Min/Max Surface Time (min)	Surface / Dive Angle	Dive Depth (m) Min/Max (Percentage)	Min/ Max Dive Time (min)	Heading Variance (angle / time)	Min /Max Speed (km/hr)	Speed Distribution	Depth limit (m) / reaction angle
Harbor Porpoise	1/1	17/31	1/10 (35%) 10/40 (45%) 40/100 (15) 100/230 (5)	1/4	30	2/7	Normal	100-1000/ reflect
Dall's Porpoise	1/1		5/94	1/2	30	6/16	Normal	deeper than 100 m
Guadalupe Fur Seal	0.5/2 0.5/1 1/2 1/2		0/5 (73) 5/50 (22) 60/100 (2) -1/5 (3)	1/4 2.4/4.2 4.2/7.7 1/4		5/9 5/9 5/9 0/1		
Northern Fur Seal (on shelf)	0.5/2 1/2 1/2		0/5 (57) 100/150 (26) -1/5 (17)	1/4 3/7 1/4		4.0/6.5 4.0/6.5 0/1		>200 /reflect
Northern Fur Seal (off shelf)	0.5/2 1/2 1/2		0/5 (57) 30/75 (26) -1/5 (17)	1/4 1/4 1/4		4.0/6.5 4.0/6.5 0/1		<1000 /reflect
Steller Sea Lion (winter)	3/8		4/10 (54) 10/50 (37) 50/250 (10)	0/2 2/4 4/8		3/10		
Steller Sea Lion (summer)	3/8		4/10 (35) 10/50 (61) 50/250 (3)	0/1 1/4 4/8		3/10		
California Sea Lion	2/3		8/75 (96) 75/224 (4)	1/3 4/8		6/12	0/0	
Hawaiian Monk Seal	1/2		50/500	4/12	30	2/9	Normal	
Northern Elephant Seal (male)	1.8/3.6	45	328/404	21.5/26.1		2.1/5.4		
Northern Elephant Seal (female)	1.5/2.7	45	437/535	22.1/26.9		2.1/5.4		

Table C-3. Dive parameters of the marine mammal species modeled for risk assessment to acoustic exposure.

MODELED SPECIES	MIN/MAX SURFACE TIME (MIN)	SURFACE / DIVE ANGLE	DIVE DEPTH (M) MIN/MAX (PERCENTAGE)	MIN/ MAX DIVE TIME (MIN)	HEADING VARIANCE (ANGLE / TIME)	MIN /MAX SPEED (KM/HR)	SPEED DISTRIBUTION	DEPTH LIMIT (M) / REACTION ANGLE
Harbor Seal	0.33/1 0.33/1 0.33/1 1/4	30/70	0/5 (40) 5/20(15) 50/150(5) -1/5(40)	0.5/2 0.5/2 4/7 1/4		1/4		

C-2.3.2.2 Fin Whale (*Balaenoptera physalus*)

Surface Time

Remarkably good data for surface times exist for fin whales. A log survivorship analysis of all inter-blow intervals was used to determine an inflection point of 28 and 31 sec between surface and dive activity for feeding and non-feeding animals, respectively (Kopelman and Sadove, 1995). The mean surface duration for fin whales, without boats present, off Maine was 54.63 sec (SD = 59.61) while dive times were 200.84 sec (SD = 192.91) (Stone et al., 1992).

Dive Depth

Foraging fin whales had mean dive depths of 97.9 +/- 32.59 m, while traveling fin whales had mean dive depths of 59.3 +/- 29.67 m (Croll et al., 2001a). Migrating fin whales were determined to have a maximal dive depth of 364 m (Charif et al., 2002). Fin whales in the Mediterranean Sea typically dove to about 100 m, and occasionally dove to 470 m, or more (Panigada et al., 1999), however these are unusually deep dives. The animats here model the more typical dive pattern 90% of the time. Foraging fin whales off California had a mean maximum dive depth of 248 m (Goldbogen et al., 2006). Based on this study, the most frequent AIM dive depth is extended to 250 m.

Dive Time

Foraging fin whales had mean dive times of 6.3 +/- 1.53 min, while traveling fin whales had mean dive time of 4.2 +/- 1.67 min (Croll et al., 2001a). The maximum dive time observed was 16.9 min. Fin whales off the east coast of the U.S. were observed to have mean dive times of 2.9 min. Ranges for the dive times of feeding animals ranged from 29 to 1001 sec, while non-feeding animals had longer dives between 32 and 1212 sec (Kopelman and Sadove, 1995). (Panigada et al., 1999) found that shallow (<100m) dives had a mean dive time of 7.1 min, while deeper dives had dive times of 11.7 and 12.6 min. Fin whales foraging on Jeffrey's Ledge in the Gulf of Maine had mean dive times of 5.83 to 5.89 min (Ramirez et al., 2006).

Speed

(Watkins, 1981) reported a mean speed of 10 km/hr, ranging from 1 to 16 km/hr, with bursts of 20 km/hr reported. Mean descent speeds of 3.2 m/sec (SD = 1.82) and ascent speeds of 2.1 m/sec (SD=0.82) have been reported from fin whales in the Mediterranean (Panigada et al., 1999).

Habitat

Fin whales are found feeding on shallow banks and in bays (Woodley and Gaskin, 1996) as well as in the abyssal plains of the ocean (Watkins, 1981). Thus fin whales are allowed to move into shallow water in AIM, with a 30 meter inshore limit to keep them out of the very shallow waters.

Group Size

In the Gulf of Mexico fin whales had a mean group size of 5.7, with a range in group sizes from 1 to 50 (Silber et al., 1994). In the Mediterranean sea the mean group size over a number of years was 1.75 animals (Panigada et al., 2005).

C-2.3.2.3 Sei/Bryde's Whale (*Balaenoptera borealis* and *B. edeni*)

There are a paucity of data for these species. Since they are similar in size, data for both species have been pooled to derive model parameters for these species.

Surface Time

No direct data were available so fin whale values were used.

Dive Depth

No direct data were available, fin whale values were used.

Dive Time

Dive times ranged between 0.75 and 11 min, with a mean duration of 1.5 min (Schilling et al., 1992). Most of the dives were short in duration, presumably because they were associated with surface or near-surface foraging. The same paper reported surface times that ranged between 2 sec and 15 min.

Heading Variance

Observations of foraging sei whales found that they had a very high reorientation rate, frequently resulting in minimal net movement (Schilling et al., 1992).

Speed

Brown (1977) reported an overall speed of advance from tagged sei whales as 4.6 km/hr. The highest speed reported for a Bryde's whale was 20 km/hr (Cummings, 1985). A Bryde's whale being attacked by killer whales traveled approximately 9 km in 94 min, with most of the travel occurring in the first 50 min, producing an estimated speed of 10.8 km/hr (Silber et al., 1990). The maximum speed of sei whales reported from a satellite tracking study was 7.6 m/sec, although the distribution of speeds was highly skewed toward lower values (Olsen et al., 2009). The speed parameters used in AIM are 0 to 20 km/hr, using a gamma distribution with alpha and beta parameters of 5 and 1 (Figure C-5), which covers the reported range of speed reported by Olsen et al. (2009) and approximated the mean value reported by Brown (1977).

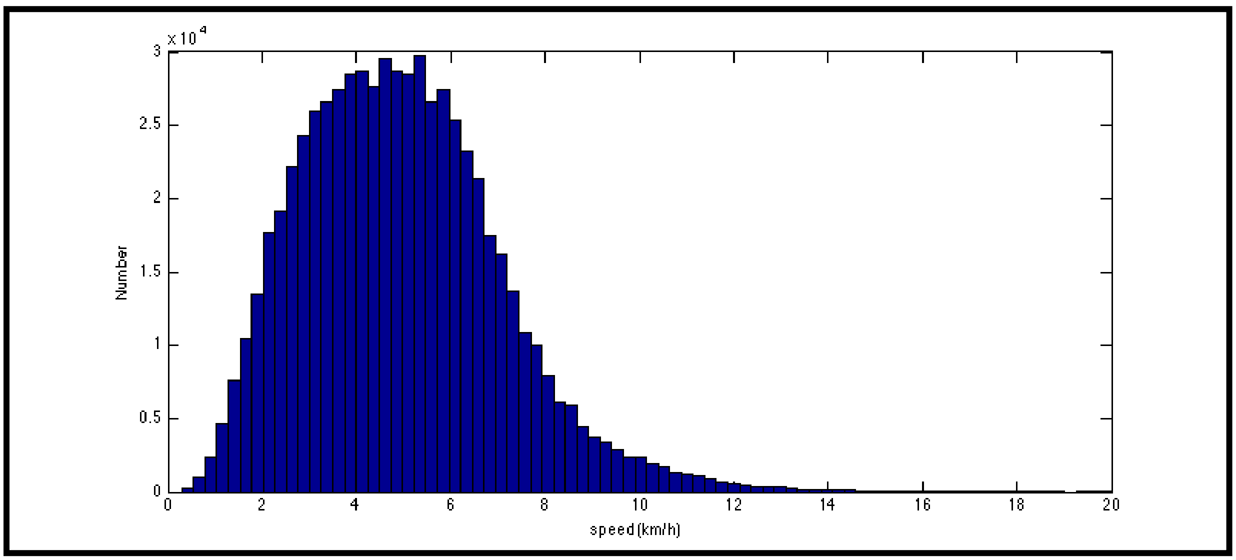


Figure C-5. Bryde's whale speed distribution.

Habitat

Sei whales are known to feed on shallow banks, such as Stellwagen Bank (Kenney and Winn, 1986). Therefore, Sei and Bryde's whales are allowed to move into shallow water.

Group Size

Sei whales in the Gulf of Maine were seen in groups of 1 to 6 animals with a mean group size of 1.8 whales (Schilling et al., 1992). Bryde's whales in the Gulf of California were seen in groups of 1 to 2 animals, with a mean size of 1.2 whales (Silber et al., 1994).

C-2.3.2.4 Minke Whale (Balaenoptera acutorostrata)

Surface Time

A mean surface time of 1.72 min, with a range of 0.63 to 2.35 min was reported by Stern (1992).

Dive Depth

Inferred from other species; however, reduced in depth, since minke whales are likely to be pelagic feeders, feeding on species found near the surface (Olsen and Holst, 2001).

Dive Time

The mean dive time of 4.43 +/- 2.7 min was reported by Stern (1992). Dive times measured off Norway range from approximately 1 to 6 min (Joyce et al., 1989). Dive times also show small diel and seasonal variability (Stockin et al., 2001), but the variability is small enough to be considered not significant for AIM modeling. Dive times were non-normal (Figure C-6) (Øien et al., 1990).

Speed

The mean speed value for minke whales in Monterey Bay was 8.3 +/- 6.4 km/hr (4.5 +/- 3.45 knots) (Stern, 1992). Satellite tagging studies have shown movement of up to 79 km/day (3.3 km/hr). Minke whales being pursued by killer whales were able to swim at 15 to 30 km/hr (Ford et al., 2005). A gamma function was fit to the available speed data (Figure C-7). The modal speed of this function is 4.5 km/hr, matching the Stern (1992) data, and has a maximum of 18 km/hr, somewhat less than the maximum speed achievable (30 km/hr), observed during predation.

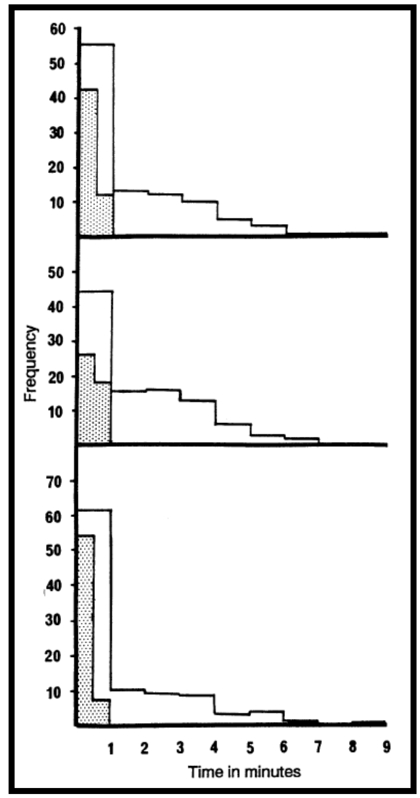


Figure C-6. Minke whale dive durations (Øien et al., 1990).

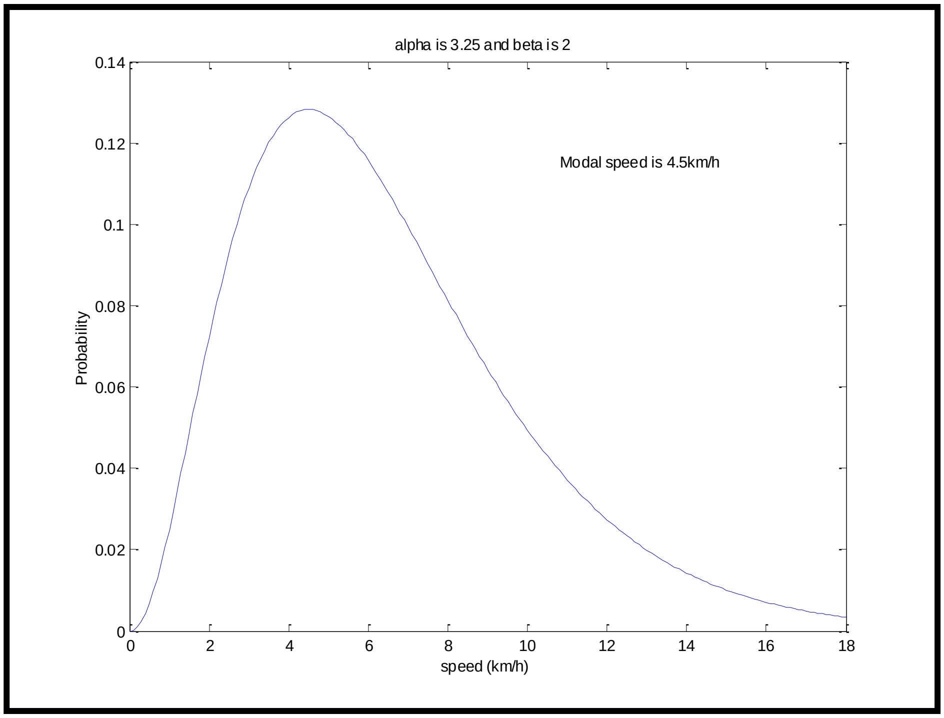


Figure C-7. Speed distribution for the minke whale.

<u>Habitat</u>

Minke whales in Monterey Bay were reported to be at a median depth of 48.6 m (Stern, 1992). They are known to move into very shallow water as well as deep oceanic basins. The 10 meter limit and reflection aversion are intended to let minke whales roam freely, but to stay off the beach.

<u>Group Size</u>

Minke whales in the Gulf of California were seen in group sizes of 1 to 50, with a mean size of 5.7 (Silber et al., 1994).

<u>Residency</u>

Foraging minke whales have been shown to exhibit small-scale site fidelity (Morris and Tscherter, 2006). Therefore, foraging minke whales should have their course change parameters set to be variable to allow for small net movements.

C-2.3.2.5 Humpback Whale (*Megaptera novaeangliae*) (Migrating)

<u>Surface Time</u>

Approximately 65% of all surfacings observed in Alaska were 2 min in length or less (Dolphin, 1987b). Surface times in Hawai‘i are similar, with the exception of surface-active groups (SAGs) (Bauer et al., 1995).

Dive Depth

Humpback whale dive depths have been measured on the feeding grounds, with 75% of dives ranging to 40 m or less (Dolphin, 1988). It is likely that migrating animals would also predominantly dive to these shallow depths.

Dive Time

Surface times range between 1 and 2 min, while dive times range between 5 and 10 min (Gabriele et al., 1996).

Heading Variance

Set very low for migrating animals. Most non-competitive group breeding animals also have linear travel. Migrating humpbacks swam very close to magnetic north from Hawai'i with very little deviation (Mate et al., 1998).

Speed

The mean speed for humpback whales is about 4.5 km/hr. The measured range is 2 to 11.4 km/hr (excluding stationary pods) (Gabriele et al., 1996). Satellite-tracked migrating humpback whales moved at a minimum of 150 km/day (6.25 km/hr) for a mother and calf pod, while another two whales moved 110 km/day (4.5 km/hr). Humpbacks off Australia were estimated to migrate at a mean speed of 8 km/hr, with a range between 4.8 to 14.2 km/hr (Chittleborough, 1953). More recent studies of Australian humpbacks found a mean northern migration speed of 5.47 km/hr, while the southern migration speed had a mean of 5.02 km/hr for non-calf pods, while calf pods had mean speeds of 5.03 and 4.25 km/hr (Chaudry, 2006).

Habitat

Migrating humpbacks swim both along the coast (California population) as well as through the oceanic abyssal plains. Humpbacks that swim along coastal regions are known to swim further offshore than gray whales. Therefore, the minimum depth for this species has been set at 100 m. Non-calf pods migrating off Australia had a mean offshore distance of 3.2 km during the northern migration and 2.6 km during the southern migration. Calf pods migrated “significantly” closer inshore (Chaudry, 2006).

C-2.3.2.6 Humpback Whale (*Megaptera novaeangliae*) (Feeding)

Surface Time

Approximately 65% of all surfacings were 2 min in length or less (Dolphin, 1987b).

Dive Depth

Humpback whale dive depths have been measured on the feeding grounds. 75% of their dives were to 40 m or less with a maximum depth of 150 m (Dolphin, 1988). Dive depth appears to be determined by prey distribution. Whales in this study were primarily foraging on euphasids. There is also a strong correlation of dive depth and dive time and is described by the following equation (Dolphin, 1987b).

Feeding humpbacks off Kodiak Alaska had a mean maximum dive depth of 106.2 m, with 62% of the dives occurring between 92 and 120 m, with a maximum of about 160 m (Witteveen et al., 2008) (Figure C-8). The humpbacks appeared to be feeding largely on capelin and pollock. There are strong differences in the data between these two studies. These differences may reflect the distribution of prey rather than behavioral abilities of the whales.

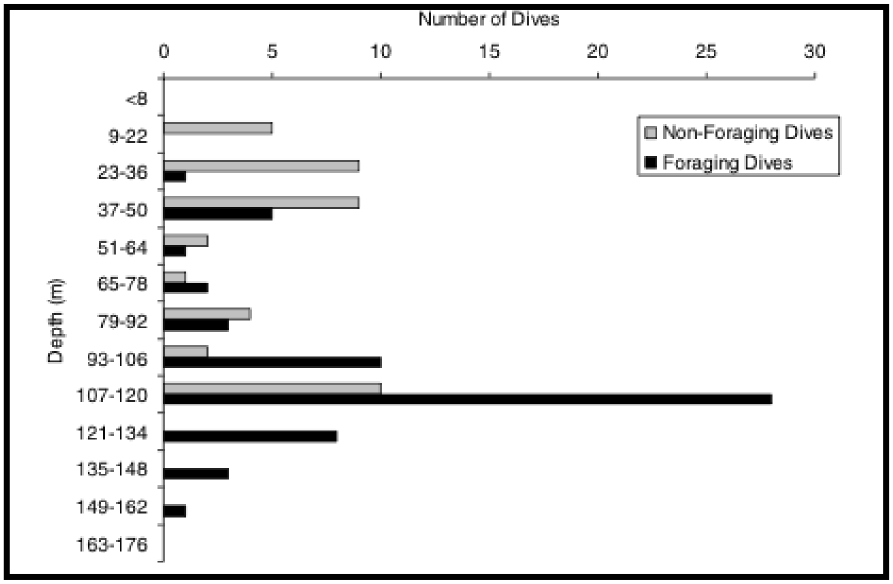


Figure C-8. Frequency distribution of feeding humpback whale mean maximum dive depths in 14 m (1 SD of mean maximum dive depth) depth bins for dives recorded from tagged humpback whales (Witteveen et al., 2008).

Dive Time

The maximum of the continuous portion of the distribution of dive times was 15 min (Dolphin, 1987b). The distribution was skewed toward shorter dives. Several dive steps can be programmed in AIM to capture this variability.

Heading Variance

Set very low for migrating animals. Most non-competitive group breeding animals also have linear travel. Migrating humpbacks swam very close to magnetic north from Hawai‘i with very little deviation (Mate et al., 1998).

Speed

Mean speeds for humpbacks are near 4.5 km/hr. The measured range is 2 to 11.4 km/hr (excluding stationary pods) (Gabriele et al., 1996). Ascent rates during dives range from 1.5 to 2.5 m/sec, while descent rates range between 1.25 and 2 m/sec (Dolphin, 1987a). The mean speed for all pod types in Glacier Bay was 3.31 km/hr (Baker and Herman, 1989).

Habitat

Migrating humpbacks swim both along the coast (California population) as well as through the oceanic abyssal plains. Humpbacks that swim along coastal regions are known to swim further offshore than gray whales. Therefore, the minimum depth for this species has been set at 100 m.

Group Size

96% of 27,252 pods in the Gulf of Maine were composed of 1 to 3 animals, with a modal size of one adult (Clapham, 1993).

C-2.3.2.7 Humpback Whale (*Megaptera novaeangliae*) (Winter Grounds: Singer)

<u>Surface Time</u>

Singing humpback whales typically surface for <1 min. Singing humpback whales in the Caribbean blew between 2 and 8 times per surfacing (Chu, 1988).

<u>Dive Depth</u>

Humpback singers inhabit relatively shallow depths.

<u>Dive Time</u>

Dive times typically range from 10 to 25 min. Observations of 20 singing humpback whales in the Caribbean found dive times between 5 and 20 min in duration (Chu, 1988).

<u>Heading Variance</u>

Set very low for singers. While traveling very slowly, even up to becoming nearly stationary, they tend to swim along the coast.

<u>Speed</u>

Most singers are stationary, although a very few move at high speeds.

<u>Habitat</u>

On the wintering grounds, most singers are found within the 100 fathom isobath, but a few are found in deeper waters. The density for these animals would be less.

<u>Group Size</u>

The vast majority of singers are found alone. The largest pod containing a singer that has been reported was four animals (Frankel et al., 1995).

C-2.3.2.7 Humpback Whale (*Megaptera novaeangliae*) (Calf)

<u>Surface Time</u>

Calves can be on the surface for an extended time, compared to adults.

<u>Dive Depth</u>

Dive depths have not been measured for calves, but are likely to be less than 30 m on the wintering grounds.

<u>Dive Time</u>

Dive times for calves range between 2 and 5 min.

<u>Heading Variance</u>

Heading variances can be relatively high.

<u>Speed</u>

Calf pods tend to be relatively slow moving.

<u>Habitat</u>

Humpbacks on the wintering grounds are most common within the 100 fathom isobath, although they are found in deeper waters in lower densities.

Group Size

Calves are almost always found with their mother. Weaning typically occurs when the calf is one year old, after which calves are considered independent.

C-2.3.2.8 Humpback Whale (*Megaptera novaeangliae*) (Winter Ground and Migrating Adult)

Surface Time

Approximately 65% of all surfacings observed in Alaska were 2 minute in length or less (Dolphin, 1987b). Surface times in Hawai'i are similar, with the exception of surface active groups (SAGs) (Bauer et al., 1995)

Dive Depth

The maximum dive depth reported for a humpback on the Hawaiian winter grounds was 176 m (Baird et al., 2000). The distribution of dive depths was strongly skewed toward shallower dives. The mean time at depth for all of their animals is shown in Table C-4.

Table C-4. Humpback whale dive distributions.

DEPTH CATEGORY (M)	MEAN % TIME IN DEPTH CATEGORY	SD	CUMULATIVE % TIME
1-10	39.55	20.57	39.55
11-20	26.51	13.29	66.06
21-30	11.65	11.84	77.71
31-40	4.25	2.77	81.96
41-50	3.04	2.28	85.00
51-60	2.47	2.28	87.47
61-70	2.14	1.73	89.61
71-80	1.66	1.54	91.27
81-90	1.97	1.91	93.24
91-100	1.55	2.36	94.79
101-110	1.39	2.17	96.18
111-120	1.31	2.33	97.49
121-130	0.92	1.75	98.41
131-140	0.72	1.73	99.13
141-150	0.30	0.56	99.43
151-160	0.23	0.40	99.66
161-170	0.15	0.26	99.81
171-180	0.09	0.22	99.90

Dive Time

Surface times range between 1 and 2 min, while dive times range between 5 and 10 min (Gabriele et al., 1996).

Heading Variance

Most non-competitive group breeding animals also have largely linear travel.

Speed

Mean speeds for humpbacks are near 4.5 km/hr while the measured range is 2 to 11.4 km/hr (excluding stationary pods) (Gabriele et al., 1996). Fitted Gamma curve parameters (Table C-5) and the humpback whale speed distribution (Figure C-9) are shown below.

Table C-5. Gamma curve parameters for Figure C-8.

TYPE	PARAMETER	ESTIMATE	LOWER 95%	UPPER 95%
Shape	Alpha	2.326775	2.255537	2.398012
Scale	Sigma	1.617174	1.561936	1.672412
Threshold	Theta	0.000000	1.570127	

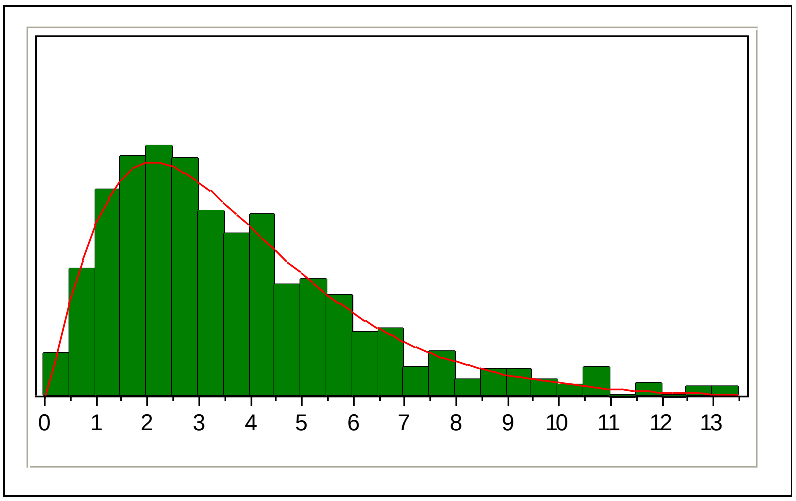


Figure C-9. Humpback whale speed histogram for pods in Hawai'i (km/hr).

Group Size

The modal group size in Hawai'i was 2 adults (Mobley and Herman, 1985)

Habitat

Migrating humpbacks swim both along the coast (California population) as well as through the oceanic abyssal plains. Humpbacks that swim along coastal regions are known to swim further offshore than gray whales. Therefore, the minimum depth for migrating animals has been set at 100 m.

C-2.3.2.9 North Atlantic Right Whale (*Eubalaena glacialis*)

Surface Time

Mean surface time for northern right whales was less than 60 sec (Winn et al., 1995). Therefore, a one minute surface time was used for AIM.

Dive Depth

Northern right whale feeding dives in the northwest Atlantic were characterized by rapid descent to depths between 80 and 175 m. The median depth was 119 m with a 90% confidence interval between 113 and 130 m (Baumgartner and Mate, 2003). This 95% confidence range was used for the dive depth range. In a nearby area, right whales dove to depths between approximately 120 and 180 m (Nowacek et al., 2004).

Dive Time

The median dive time for foraging northern right whales was 12.65 min, with a 95% confidence interval of 11.4 to 12.9 min (Baumgartner and Mate, 2003).

Speed

Descent speed of diving northern right whales had a 95% confidence interval of 1.3 to 1.5 m/sec, while the ascent speed was 1.4 to 1.7 m/sec (Baumgartner and Mate, 2003). Radio-tagged whales that remained in the Bay of Fundy had a mean speed of 1.1 km/hr, while those that left the bay had a mean speed of 3.5 km/hr (Mate et al., 1997). Note that radio-tagging tends to underestimate whale speed, since the data greatly smooth the recorded course of the animal

Habitat

Northern right whales are currently found in the northwest Atlantic Ocean and the North Pacific Ocean. In the North Atlantic, they range from the Bay of Fundy area during the summer foraging season. They migrate along the coast and their breeding area is in the shallow waters offshore of Florida and Georgia. It is believed that a portion of the population migrates to an undiscovered location.

Group Size

The group size of surface active groups (SAGs) in the Bay of Fundy ranged from 2 to 15 animals (Parks and Tyack, 2005).

C-2.3.2.10 Gray Whale (*Eschrichtius robustus*)

Surface Time

Most of the surface times for summering gray whales fell in the range of 0 to 2 min (Würsig et al., 1986).

Dive Depth

No dive depth data for migrating grays were available. However, the near shore habitat of migrating gray whales makes the estimated ranges of 10 to 40 m a reasonable estimate. Summering (foraging) gray whales are presumed to dive to depths between 10 m and the local bottom depth, since they are bottom feeders (Nerini, 1984).

Dive Time

Gray whales migrating past Unimak Island in Alaska were recorded to have dive times between 3 and 700 sec (Rugh, 1984). However, numerous other papers cite a minimum dive time of 3 min or longer (Wyrick, 1954; Rice and Wolman, 1971). Therefore, the values of 3 to 12 min were used in the modeling. Summering gray whales appear to have shorter dive times, ranging up to approximately 7 min, with a mean near four min (Würsig et al., 1986).

Speed

Tagged migrating gray whales have been documented to cover between 31.4 and 125 km/day (Mate and Harvey, 1984). A maximum speed of 9 km/hr was calculated by Rice and Wolman (1971). Summering (foraging) gray whales were measured at 2.3 +/-2.18, 2.3 +/- 1.75 and 2.8 +/- 2.23 km/hr (Würsig et al., 1986). Therefore, summering gray whales are programmed to swim between 1 and 5 km/hr

Habitat

Gray whales are famous for migrating very close to shore. They will occasionally cross the mouths of bays (e.g., San Diego) which may take them further offshore. Therefore, their inshore depth limit is set at 10 m, a depth from which they will ‘reflect’ or move seaward in the model. All gray whales are currently set to avoid waters deeper than 100 m.

Group Size

Migrating gray whales off California had slightly different pod sizes during the day and the night (mean day = 1.75 ± 0.280, mean night = 1.63 ± 0.232) (Perryman et al., 1999). Foraging western gray whales off Sakhalin Island, Russia had pod sizes ranging from 1 to 3, with a mean size of 1.2 animals (Weller et al., 2002).

C-2.3.2.11 Sperm Whale (*Physeter macrocephalus*)

Surface Time

Male sperm whales in New Zealand had a mean duration on the surface of 9.1 min, with a range of 2 to 19 min (Jaquet et al., 2000). The distribution of surface times was non-normal, with 68% of the surface times falling in between 8 and 11 min. These values were used for AIM modeling.

Surfacing and Dive Angles

Surfacing angles of 90° and diving angles between 60° and 90° have been reported (Miller et al., 2004).

Dive Depth

The maximum, accurately measured, sperm whale dive depth was 1,330 m (Watkins et al., 2002). Foraging dives typically begin at depths of 300 m (Papastavrou et al., 1989). Sperm whale diving is not uniform. As an example of this, data from a paper on sperm whale diving reported different dive types for the sperm whales in their study (Amano and Yoshioka, 2003). AIM can now accommodate these different dive types, at different frequencies of use (Table C-6).

Dive depths have also been shown to have diel variation in some areas, while others do not show this variation (Aoki et al., 2007). These differences have been attributed to the behavior of the prey species. Off California, tagged whales changed their dive patterns in response to changes in the depth of tagged squid (Davis et al., 2007). Male sperm whales foraging in high-latitude waters dove to a maximum depth of 1,860 m, but the median dive depth was only 175 m (Teloni et al., 2008).

Dive Time

Sperm whale dive times average 44.4 min in duration and range from 18.2 to 65.3 min (Watkins et al., 2002).

Speed

Sperm whales are typically slow or motionless on the surface. Mean surface speeds of 1.25 km/hr were reported by Jaquet et al.(2000) and 3.42 km/hr Whitehead et al.(1989). Their mean dive rate ranges from 5.22 km/hr to 10.08 km/hr with a mean of 7.32 km/hr (Lockyer, 1997). In Norway, horizontal swimming speeds varied between 0.2 and 2.6 m/sec (0.72 and 9.36 km/hr) (Wahlberg, 2002). Sperm whales in the

Table C-6. Sperm whale diving parameters (Amano and Yoshioka, 2003).

Type of Dive	N	Depth (m)		Time (min)	
		Min	Max	Min	Max
Dives w/ active bottom period	65	606	1082	33.17	41.63
Dives w/o active bottom period	4	417	567	31.29	33.71
V shaped dives	3	213	353	12.77	20.83
Total	74				

Note: The dive data in this table are for only the sperm whales in the Amano and Yoshioka study. These data do not equate to the values used in AIM. For example, the table shows minimum and maximum dive times as 12.77 and 41.63 min respectively, while the AIM values are 18.2 and 65.3 min respectively, as stated below under dive time.

Atlantic Ocean swam at speeds between 2.6 and 3.5 km/hr (Watkins et al., 1999; Jaquet and Whitehead, 1999). Based on these data, a minimum speed of 1 km/hr, and a maximum speed of 8 km/hr was set for sperm whales, specified with a normal distribution, so that mean speeds will be about 4 km/hr.

Habitat

Sperm whales are found almost everywhere, but they are usually in water deeper than 480 m (Davis et al., 1998). However, there have been sightings of animals in shallow water (40 to 100 m) (Scott and Sadove, 1997, Whitehead et al., 1992). In the Gulf of California, there was no relationship between depth or bathymetric slope and abundance, and animals were seen in water as shallow as 100 m (Jaquet and Gendron, 2002). Based on these reports, a compromise value of 200 m is used as the shallow water limit for sperm whales.

Group Size

Social, female-centered groups of sperm whales in the Pacific have 'typical' group sizes of 25 to 30 animals, based on the more precise measurements in Coakes and Whitehead (2004); although, less precise estimates are as high as 53 whales in a group.

C-2.3.2.12 Dwarf and Pygmy Sperm Whales (*Kogia* spp.)

Data on dwarf and pygmy sperm whales are rare, and these species are very similar, so data for these two species have been combined.

Surface Time

Observations of *Kogia* off Hawaii found that they logged at the surface for up to a "few" minutes then dove (Baird, 2005).

Dive Depth

In the Gulf of Mexico, *Kogia* were found in waters less than 1000 m, along the upper continental slope (Baumgartner et al., 2001). Therefore, the dive limits of 200 to 1000 m were chosen based on similar species diving deeply to feed, and within the physical constraints of the environment. It should be noted that *Kogia* have been seen in water almost 2000 m deep (Davis et al., 1998), but they may not be diving to the bottom.

Dive Time

Maximum dive time reported for *Kogia* is 12 min (Hohn et al., 1995). A rehabilitated pygmy sperm whale made long dives from 2 to 11 min in length at night, and shorter dives during the day (Scott et al., 2001).

<u>Speed</u>

Tracking of a rehabilitated pygmy sperm whale found that speeds range from 0 to 6 knots (11 km/hr) with a mean value of 5.6 km/hr (3 knots) (Scott et al., 2001).

<u>Habitat</u>

The minimum depth that *Kogia* were found in the Gulf of Mexico was 176 m (Davis et al., 1998). Off Hawai‘i, they were found in waters between 450 and 3200 m depth, with a mean depth of 1425 m (Baird, 2005). *Kogia* in the Philippines were found in waters from 117 to 3744 m in depth (Dolar and Perrin, 2003).

<u>Group Size</u>

Group sizes off Hawai‘i ranged between 1 and 6 animals (Baird, 2005) and group sizes in the Gulf of Mexico range between 1 and 3 (Mullin et al., 2004).

C-2.3.2.13 Beaked Whales (Family Ziphiidae)

Data on the behavior of beaked whales is sparse. Therefore, beaked whale species have been pooled into a single animat that is used to model all beaked whale species.

<u>Surface Time</u>

Surface times in Arnoux’s beaked whales ranged from 1.2 to 6.8 min (Hobson and Martin, 1996). Sowerby’s beaked whales had surface times of 1 to 2 min, during which they would blow 6 to 8 times (Hooker and Baird, 1999b)

<u>Dive Depth</u>

The minimum and maximum dive depth measured for a beaked whale was 120 and 1453 m, respectively (Hooker and Baird, 1999a). *Ziphius* tagged off the Canary Islands had foraging dives between 824 m and 1267 m, while Blainsville’s beaked whales dove to depths between 655 m and 975 m (Johnson et al., 2004).

Northern bottlenose whales performed shallow dives with a range of 41 to 332 m (n=33), while deep dives ranged from 493 to 1453 m (n=23). Dive depth and dive duration were strongly correlated (Hooker and Baird, 1999a).

<u>Dive Time</u>

The minimum and maximum dive time measured was 16 and 70.5 min, respectively (Hooker and Baird, 1999a). Sowerby’s beaked whales had dives between 12 and (at least) 28 min in the Gully in Canada (Hooker and Baird, 1999b). Arnoux’s beaked whale had modal dive times between 35 to 65 min (mean = 46.4 min, SD = 13.1), with a maximum dive time of at least 70 min (Hobson and Martin, 1996). Tagging results with *Ziphius* had one animal diving for 50 min (Johnson et al., 2004). *Mesoplodon stejnegeri* were observed to dive for “10 to 15 min” in Alaska (Loughlin, 1982)

<u>Heading Variance</u>

Sowerby’s beaked whales surfacing in the Gully were reported to have no apparent orientation, and would change orientation up to 180° between surfacing (Hooker and Baird, 1999b).

<u>Speed</u>

Dive rates averaged 1 m/sec or 3.6 km/hr (Hooker and Baird, 1999a). A mean surface speed of 5 km/hr was reported by (Kastelein and Gerrits, 1991).

Habitat

The minimum sea depth in which beaked whales were found in the Gulf of Mexico was 253 m (Davis et al., 1998). In the Gully in Canada, Sowerby's beaked whales were found in water ranging from 550 to 1500 m in depth (Hooker and Baird, 1999b). Blainsville's beaked whales (*M. densirostris*) were found in water depths of 136 to 1319 m in the Bahamas, and were found most often in areas with a high bathymetric slope (MacLeod and Zuur, 2005). *Mesoplodons* were found in waters from 700 m to > 1800 m off Scotland and the Faroe Islands (Weir, 2000) and between 680 and 1933 m in the Gulf of Mexico (Davis et al., 1998).

Group Size

Mesoplodon stejnegeri in Alaska had pod sizes between 5 and 15 animals (Loughlin, 1982). Sowerby's beaked whales in the Gully in Canada had group sizes between 3 and 10 (Hooker and Baird, 1999b). Dense-beaked whales off the Canary Islands had group sizes ranging between 2 and 9 with a mean size of 3.44 whales (Ritter and Brederlau, 1999). Sightings of Longman's beaked whale in the western Indian ocean found group sizes between 1 and 40, with a mean size of 7.2 whales (Anderson et al., 2006).

C-2.3.2.14 Killer Whale (*Orcinus orca*)

There is a remarkable paucity of quantitative data available for killer whales, considering their coastal habitat and popular appeal. Nevertheless, most data from "blackfish" were used to model orca, with the exception of dive depth. The different feeding ecology of these species makes very deep dives apparently unnecessary. When additional data allow, separate animats will be developed for "resident" and "transient" killer whales.

Dive Depth

Killer whales feeding on herring were observed to dive to 180 m (Nøttestad et al., 2002). Killer whales are found in at least two "races", transients and residents. Transients feed primarily on marine mammals, whereas residents feed primarily on fish. Residents were reported to dive to the bottom (173 m) (Baird, 1994). Baird (1994) also reported that while residents dive deeper than transients, the transients spent a far greater amount of time in deeper water. Individual resident killer whales in the Pacific northwest had maximum dive depths ranging between 24 and 264 m, with a group mean maximum depth of 140.8 m (SD=61.8, n=34) (Baird et al., 2005). The distribution of dive depths in Baird et al (2005) was strongly skewed toward shallow values.

Dive Time

Daytime dive times for males were 2.79 min, significantly longer than the 2.09 minute dive times for females (Baird et al., 2005).

Speed

Uncalibrated swim speed data were presented by Baird et al.(2005). Killer whales chasing minke whales had prolonged speeds of 15 to 30 km/hr (Ford et al., 2005), although these speeds are probably obtained only during predation. A shore-based study of southern resident killer whales in Washington State had a mean speed of 9.5 km/hr, with a mean range of 4.7 to 16.1 km/hr (Kriete, 2002). The mean speed of control animals was approximately 5.3 km/hr, measured during a study of the response of killer whales to vessels (Williams et al., 2002). A similar study reported a mean speed of 6.64 km/hr without vessels and 6.478 km/hr in the presence of vessels (Bain et al., 2005). Taken together, these three studies produced a speed range of 3 to 12 km/hr for use in AIM.

Habitat

Killer whales are known to occur in very shallow water (e.g., rubbing beaches) as well as across open ocean basins. However, they are usually coastal and most often found in temperate waters.

Group Size

Killer whales in the Gulf of California were seen in groups of 2 to 15 whales, with a mean of 8.5 and a SD of 9.19 (N=2) (Silber et al., 1994). Off the Pacific coast of Costa Rica, the mean group size was 3.51 (SD = 2.99, n=7) (May-Collado et al., 2005).

C-2.3.2.15 Blackfish: False Killer Whale, Pygmy Killer Whale, Melon-Headed Whale (*Feresa*, *Pseudorca*, and *Peponocephala* spp.)

Studies describing the movements and diving patterns of these animals are rare and sparse. Therefore, they have been combined into a single “blackfish” category. As more data become available, these species will be split into separate animats.

Surface Time

No direct measurements of surface time are available, so the default value of one minute was used.

Dive Depth

The maximum dive depth of a single false killer whale off the Madeira Islands was 72 m. Most of the time was spent at depths deeper than 20 m, and the dives were V-shaped (Alves et al., 2006). Three false killer whales in Hawai‘i had shallow dives as well, with maximum depths of 22, 52 and 53 m (Ligon and Baird, 2001). It should be noted that these animals were feeding on fish.

Dive Time

No direct measurements were available, so data from pilot whales were used here (Figure C-10).

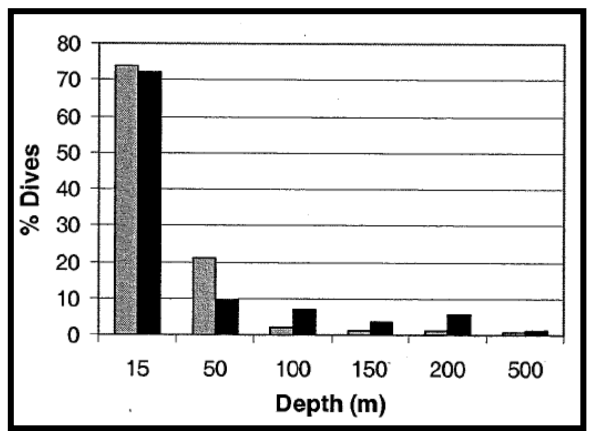


Figure C-10. Distribution of pilot whale dive depths.

Speed

Maximum speed recorded for false killer whales was 8.0 m/sec (28.8 km/hr) (Rohr et al., 2002), although the typical cruising speed is 20 to 24% less than the maximum speed (Fish and Rohr, 1999). This “typical” maximum of 6.24 m/sec (22 km/hr) was used as the maximum speed for AIM. Off the Madeira Islands false killer whales were found in water depths from 900 to 2000 m (Alves et al., 2006).

Group Size

False Killer whales in the Gulf of Mexico had group sizes between 20 and 35 (mean = 27.5, SE = 7.5, n=2) (Mullin et al. 2004). False killer whales off Costa Rica had a mean group size of 36.16 +/- 52.38 (May-Collado et al., 2005).

C-2.3.2.16 Short-finned and Long-finned Pilot Whales (*Globicephala* spp.)

There are insufficient data available to have separate animats for the two pilot whale species. Therefore they are combined into a single pilot whale animat.

Surface Time

A rehabilitated long-finned pilot whale in the North Atlantic was equipped with a satellite tag and a time-depth recorder (TDR). The log survivorship plot of dive time from this animal had an inflection point at about 40 sec (Mate et al., 2005). The authors did not feel that this qualified as a breakpoint to separate surface and dive behavior. However, it does suggest that most surface intervals are less than one minute.

Dive Depth

Long-finned pilot whales in the Mediterranean were observed to display considerable diurnal variation in their dive depths. During the day they never dove to more than 16 m. However, at night, they dove to a maximum depths of 360 and 648 m with mean depth of 308 and 416 m (Baird et al., 2002). Rehabilitated long-finned pilot whales dove to 312 m on Georges Bank, which has a depth of 360 m; so, these values should not be taken as the maximum. The distribution of dive depths was also skewed toward lower values (Nawojchik et al., 2003).

Dive Time

Baird et al. (2002) reported on dives of two individual long-finned pilot whales, which varied between 2.14 and 12.7 min during the night. Animals spent all of their time in the top 16 m during the day.

A rehabilitated long-finned pilot whale in the North Atlantic had dive times between 1 and 6 min (Mate et al., 2005). Other rehabilitated long-finned pilot whales were reported to dive for at least 25 min, although the distribution is skewed toward shorter dives, with most lasting about 2 min (Nawojchik et al., 2003). Long-finned pilot whales off the Faroe Islands never dove longer than 18 min (Heide-Jørgensen et al., 2002).

Speed

(Shane, 1995) reported a minimum speed of 2 km/hr and a maximum of 12 km/hr for pilot whales. During the day in the Mediterranean, animals slowly swam, with mean values for two animals of 0.762 and 0.885 m/sec (2.85 and 3.18 km/hr), while at night, they swam faster at 1.898 m/sec (6.83 km/hr) and 1.523 m/sec (5.48 km/hr) (Baird et al., 2002). A single satellite-tracked long-finned pilot whale had a minimum speed of 1.4 km/hr (Mate et al., 2005). The speeds of traveling pilot whales (G. *scammoni*) was estimated at 4 to 5 kts (7.4 to 9.3 km/hr) (Norris and Prescott, 1961) (cited in Mate et al., 2005). Vertical dive speeds of three TDR-tagged long-finned pilot whales ranged from 0.79 to 3.38 m/sec, with a mean of 1.99 m/sec (Heide-Jørgensen et al., 2002).

Habitat

The minimum water depth that pilot whales were seen in the Gulf of Mexico was 246 m (Davis et al., 1998) while off of Spain they preferred water deeper than 600 m (Cañadas et al., 2002).

Group Size

Short-finned pilot whales in the Gulf of Mexico ranged in group size between 5 and 50 (mean = 20.4, SE=3.6, n=11) (Mullin et al., 2004). Off the Pacific coast of Costa Rica the mean group size of pilot whales was 14.22 (SD=12.06) (May-Collado et al., 2005).

C-2.3.2.17 Risso's Dolphin (*Grampus griseus*)

Dive Depth

Dive depths of 150 to 1,000 m were inferred from its squid-eating habits, and from similar species.

Dive Time

No data on dive times could be found. The values for blackfish, which have a similar ecological niche, were used.

Speed

Risso's dolphins off Santa Catalina Island were reported to have speeds that range between 2 and 12 km/hr (Shane, 1995).

Habitat

Risso's dolphins were seen in water deeper than 150 m in the Gulf of Mexico (Davis et al., 1998). In the Gulf of Mexico, they were most often observed between 300 and 750 m. Off Chile they were seen in waters deeper than 1000 m (Olavarria et al., 2001). Off Spain, they were found to be deep water species, preferring water deeper than 600 m (Cañadas et al., 2002). In all cases this association seems to be driven by the local oceanographic upwelling conditions that increase primary prey productivity.

Group Size

In the Pacific, group sizes were measured between 1 and 220 animals, with a geometric mean of 10.7. An estimated 76.4% of the groups contained fewer than 20 animals (Leatherwood et al., 1980). Group sizes in the Gulf of Mexico ranged between 2 and 78 animals, with a mean of 12.7 (SE = 2.0, n=39) (Mullin et al., 2004). Off the Pacific coast of Costa Rica, the mean group size was 11.57 (SD=9.64) (May-Collado et al., 2005).

C-2.3.2.18 Common dolphin (*Delphinus delphis*)

Dive Depth

Dive depths are reported to be between 50 and 200 m (Evans, 1994).

Dive Time

The maximum dive time was reported to be 5 min (Heyning and Perrin, 1994).

Speed

The maximum sustainable speed for common dolphins was measured at 2.5 m/sec (9 km/hr) (Hui, 1987).

Habitat

Off the northeastern United States, common dolphins were concentrated along the shelf edge, between 100 and 200 m (Selzer and Payne, 1988). In the Mediterranean common dolphins were found in waters between 25 and 1300 m deep, with 95% of the animals in water between 247 and 326 m (Cañadas et al., 2002).

Group Size

Common dolphins in the Gulf of California were found in groups of 4 to 1,100 animals, with a mean size of 254.3 dolphins (Silber et al., 1994). Off the Pacific Coast of Costa Rica, the mean group size was 220.67 (SD=220.6) (May-Collado et al., 2005).

C-2.3.2.19 Frasier's Dolphin (*Lagenodelphis hosei*)

Dive Depth

Fraser's dolphins dive to about 600 to 700 m to feed, much deeper than spinner dolphins (Dolar et al., 2003). Numerous records indicated that the primary prey of Fraser's dolphins is found at great depth (Caldwell et al., 1976, Miyazaki and Wada, 1978, Robison and Craddock, 1983), although there has been at least one report of near-surface feeding (Watkins et al., 1994). All other behavioral parameters are taken from *Stenella* species, since there are no direct data for Fraser's dolphin. The dive time has been increased to 6 min, to account for the deeper dives.

Group Size

A single group of Fraser's dolphins was seen off the Pacific coast of Costa Rica and had a group size of 158 (May-Collado et al., 2005).

C-2.3.2.20 Bottlenose dolphin (*Tursiops truncatus*)

In many environments there can be coastal and pelagic stocks of bottlenose dolphins. This is certainly the case off the east coast of the United States. However, defining the range of offshore form is difficult (Wells et al., 1999). Regardless of the genetic differences that may exist between these two forms, they frequently occur in different densities, and so they are split into two animat categories.

Dive Depth

The maximum recorded dive depth for wild bottlenose dolphins is 200 m (Kooyman and Andersen, 1969). A satellite-tagged dolphin in Tampa Bay had a maximum dive depth of 98 m (Mate et al., 1995). This value was used as the maximum dive depth for the coastal form of bottlenose.

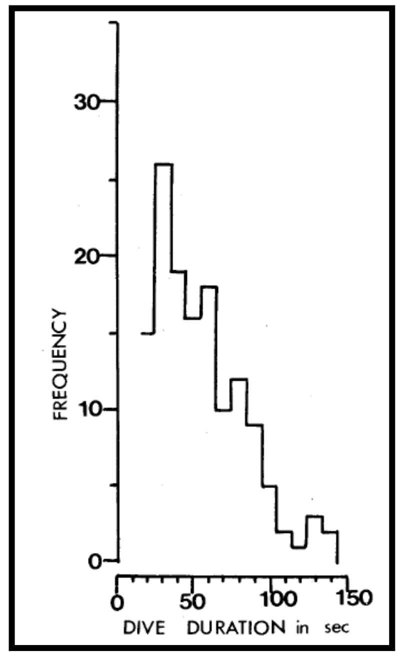


Figure C-11. Bottlenose dolphin dive durations.

Dive Time

Measured surface times ranged from 38 sec to 1.2 min (Mate et al., 1995; Lockyer and Morris, 1987; Lockyer and Morris, 1986). Dive times for a juvenile bottlenose had a mean value of 55.3 sec, although the distribution was skewed toward shorter dives (Lockyer and Morris, 1987) (Figure C-11).

Speed

Bottlenose dolphins were observed to swim, for extended periods, at speeds of 4 to 20 km/hr, although they could burst (for about 20 sec) at up to 54 km/hr (Lockyer and Morris, 1987). Dolphins in the Sado Estuary, Portugal had a mean speed of 1.2 m/sec (4.3 km/hr) and maximum speed of 3.2 m/sec (11.2 km/hr) (Harzen, 2002). A more recent analysis found that maximum speed of wild dolphins was 5.7 m/sec (20.5 km/hr), although trained animals could double this speed when preparing to leap (Rohr et al., 2002). Maximum speeds of wild dolphins in France was 4.8 m/sec, with an average speed (relative to water) of 2.2 m/sec (7.9 km/hr) (Ridoux et al., 1997). Bottlenose dolphins off Argentina swam much faster (3.9 m/sec, or 14 km/hr) when in water >10 m than while in shallow water (1.6 m/sec, or 5.8 km/hr) (Würsig and Würsig, 1979).

Habitat

In the Gulf of Mexico, bottlenose where observed in water depths between 101 and 1226 m (Davis et al., 1998). However, tagged animals have been observed to swim into water 5000 m deep (Wells et al., 1999).

Group Size

Bottlenose dolphins in the Gulf of California were seen in groups of 1 to 60 dolphins with a mean group size of 10.1 (Silber et al., 1994). In the Gulf of Mexico, they were seen in groups of 1 to 68 individuals (mean = 14.5, SE = 1.5, n=83) (Mullin et al., 2004). Off the Pacific coast of Costa Rica, the mean group size was 21.5 (SD=33.73, n=176) (May-Collado et al., 2005).

C-2.3.2.21 *Stenella* spp.: Pantropical Spotted, Atlantic Spotted, Spinner, Spotted, Striped, and Clymene Dolphins

Data for species of the genus *Stenella* are surprisingly sparse. Therefore, a single *Stenella* animat is used to represent all of the species of that genus.

<u>Dive Depth</u>

Spinner dolphins feed during the night, and rest inshore during the daytime. At night they dive to about 400 m to feed (Dolar et al., 2003). Pantropical spotted dolphins off Hawai‘i also dive deeper at night than during the day. The daytime depth had a mean of 12.8 m, with a maximum of 122 m, whereas the nighttime mean was 57 m, with a maximum of 213 m (Baird et al., 2001).

Spinner dolphins off Hawaii typically track and forage on the mesopelagic boundary layer as it migrates both vertically and horizontally at night. It appears that dolphins have to dive deeply only at the very beginning and end of the migration (Benoit-Bird and Au, 2003). Most of the time spinner dolphins forage at moderate water depths. Therefore, 10% of the dives will be set to be deep, 40% of the dives will be ‘typical’ foraging depths, with a maximum of 150 m, and 50% of the dives will represent the daytime resting behavior, ranging between 5 and 25 m.

<u>Dive Time</u>

A single spotted dolphin had dive times ranging between 1 and 204 sec (Leatherwood and Ljungblad, 1979). Pantropical spotted dolphins off Hawai‘i had a mean dive duration of 1.95 min (SD=0.92) (Baird et al., 2001). An Atlantic spotted dolphin tagged with a satellite linked TDR had a maximum dive time of 3.5 min (Davis et al., 1996). A 4-min dive time maximum was used for modeling purposes in AIM.

<u>Speed</u>

The mean speed of striped dolphins in the Mediterranean was estimated at 6.1 knots (11 km/hr), and were observed to burst to 32 kts (59.3 km/hr) (Archer and Perrin, 1999). A maximum speed of 20 km/hr was chosen as a typical (non-burst) maximum speed. A tagged spotted dolphin was tracked at estimated average speeds of 2.3 to 10.7 knots, with bursts exceeding 12 knots (22.2 km/hr) (Leatherwood and Ljungblad, 1979). The estimated burst speed of spotted dolphins in the Eastern Tropical Pacific was 6 m/sec (21.6 km/hr) for adults and 3 m/sec (10.8 km/hr) for neonates. The estimated long-term top speed is 2.5 m/sec (9 km/hr) for adults and 1 m/sec (3.6 km/hr) for neonates (Edwards, 2006). The Edwards (2006) paper also summarized speed estimates and duration for a number of species. Therefore, their estimate of 9 km/hr will be used for long-term movements, as modeled in AIM.

<u>Habitat</u>

In the Gulf of Mexico, spinner dolphins were seen in water deeper than 526 m, striped dolphins were seen in water deeper than 570 m and spotted dolphins were seen in water deeper than 102 m (Davis et al., 1998). Spinner dolphins in Hawaii are known to move into shallow bays during the day (Norris and Dohl, 1980).

<u>Group Size</u>

Group size estimates were summarized, and the majority of striped dolphin groups were less than 500 animals. The mean of the smaller groups was 101 animals (Archer and Perrin, 1999). Spotted dolphins off Costa Rica had group sizes between 1 and 50 (mean = 10.16 SD = 9.61; Table C-7) (May-Collado and Ramirez, 2005). Group size of *Stenella* dolphins in the Gulf of Mexico ranges from a maximum 210 for pantropical spotted dolphins to 48 for Atlantic spotted dolphins (Mullin et al., 2004) (Table C-8). Clymene dolphins off Costa Rica had a mean group size of 76.1 (SE = 11, n=109) (Fertl et al., 2003).

Table C-7. Group size characteristics of *Stenella* dolphins off Costa Rica (May-Collado et al., 2005).

Species	Mean	SD
Pantropical Spotted Dolphin	29.38	58.28
Striped Dolphin	48.9	43.05
Spinner Dolphin	100.59	107.7

Table C-8. Group size characteristics of *Stenella* dolphins in the Gulf of Mexico (Mullin et al., 2004).

SPECIES	MIN GROUP SIZE	MAX GROUP SIZE	MEAN	SE	N
Pantropical Spotted Dolphin	5	210	49.0	4.5	47
Atlantic Spotted Dolphin	5	48	22.4	3.9	12
Striped dolphin	7	150	46.3	16.0	8
Spinner Dolphin	48	200	91.3	36.4	4
Clymene Dolphin	9	168	59	19.5	7

C-2.3.2.22 *Lagenorhynchus* species: Atlantic and Pacific White-Sided Dolphins, Peale's, Dusky, White-Beaked and Hourglass Dolphins

Data for species of the genus *Lagenorhynchus* are sparse. Therefore, a single animat was created based on data from species of that genus.

<u>Surface Time</u>

Surface times for tagged white-sided dolphins were less than one minute (Mate et al., 1994).

<u>Dive Depth</u>

No direct data on dive depth are available for any of the *Lagenorhynchus* species. However, in the Atlantic, they feed on herring and in the Pacific they can feed on squid and mesopelagic fishes. For Atlantic white-sided dolphin, a maximum dive depth of 125 m is used, since this covers the depth range of herring. It is slightly shallower than the other dolphin species, due to the Lags' short dive time.

<u>Dive Time</u>

Maximum dive time for a tagged white-sided dolphin was 4 min, although the mean time was <1 minute (Mate et al., 1994a). Peale's dolphin (*L. australis*) dove from 1 to 130 sec (de Haro and Iniguez, 1997).

<u>Speed</u>

The mean minimum speed of 5.7 km/hr was estimated by the straight-line distance between satellite tag locations, which is almost certainly an underestimate of real world swimming speeds (Mate et al., 1994a). The maximum "minimum speed" was 14.22 km/hr. Theodolite tracking of dusky dolphins (*L. obscurus*) produced mean speeds between 3.68 and 6.08 km/hr, with 10^{th} and 90^{th} percentiles of ~2 and ~9 km/hr (Yin, 1999).

<u>Group Size</u>

The mean group size of Atlantic white-sided dolphins was 52 (Weinrich et al., 2001). The mean group size of Pacific white-sided dolphins was 30.8 (Barlow, 1995). In waters off southeast Alaska the group size was extremely variable, ranging from 1 to 500 animals, with an overall mean of 35.6 animals (Dahlheim and Towell, 1994).

C-2.3.2.23 Rough Toothed Dolphin (*Steno bredanensis*)

<u>Dive Depth</u>

No dive depth data are available. Depths are based upon other species. Since rough-toothed dolphins primarily forage on squid, a deep dive depth is chosen.

<u>Dive Time</u>

The maximum dive time reported for rough-toothed dolphins was 15 min (Miyazaki and Perrin, 1994). A more typical range was 0.5 to 3.5 min (Ritter, 2002).

<u>Speed</u>

Bow-riding Steno were observed at 16 km/hr (Watkins et al., 1987). Porpoising *Steno* off the Canary Islands were tracked at >3 knots (Ritter, 2002).

<u>Habitat</u>

Rough-toothed dolphins were seen in water deeper than 194 m (Davis et al., 1998). Dolphins off the Canary Islands were most often seen in water 100 to 1000 m deep, with occasional shallow water sightings, and one group was seen in water 2,500 m deep (Ritter, 2002). Off French Polynesia, animals were found between 1.8 and 5.5 km offshore, in water between 1,000 and 2,000 m (Gannier and West, 2005).

<u>Group Size</u>

Rough-toothed dolphins off French Polynesia had a mean group size of 10.8 individuals, with a range of 1 to 35 animals (Gannier and West, 2005). Off the Pacific coast of Costa Rica the mean size was 19.31 (SD=21.8) (May-Collado et al., 2005).

C-2.3.2.24 Right Whale Dolphin (*Lissodelphis* spp).

<u>Dive Depth</u>

Right whale dolphins are known to feed on myctophids and *Loglio* squids (Leatherwood and Walker, 1979). This information is used to estimate foraging depths.

<u>Dive Time</u>

Dive times of up to 6.25 min have been recorded (Leatherwood and Walker, 1979).

<u>Speed</u>

Observations of southern right whale dolphins were tracked bow-riding at speeds up to 12.5 km/hr (Rose and Payne, 1991). Other observations have reported them moving at 32 to 35 km/hr or >18 kts (Leatherwood and Walker, 1979). Other observations also report slow swimming and ‘gamboling’ as well (Nishiwaki, 1972; Rose and Payne, 1991). It is likely that speeds in this species have a bimodal distribution.

Habitat

Northern right whale dolphins have frequently been seen with Pacific white-sided dolphins (Tynan et al., 2005). They have also been seen with dusky dolphins and pilot whales (Cruickshank and Brown, 1981).

Group Size

Mean group size off South Africa was 368 (Rose and Payne, 1991). Survey efforts off the coast of California found that most schools (13 of 15 sighted) had a mean group size of 9.9, while two larger schools had a mean of 75.7 dolphins (Barlow, 1995).

C-2.3.2.25 Harbor Porpoise (*Phocena phocena*)

Surface Time

Mean surface time was reported as 3.9 sec (Otani, 2000).

Dive Depth

Maximum observed dive depth for a free-ranging harbor porpoise was 64.7 m (Otani, 2000). However, the same study reported that >90% of dives were less than 10 m. Another TDR study with seven animals tagged had dive depths that ranged from a mean of 14 +/- 16 m to 41 +/- 32 m, while the mean for all animals tagged was 25 +/- 30 m (Westgate et al., 1995). One large female made a very deep dive to 226 m, although dives this deep were infrequent.

Dive Time

Maximum observed dive time for a free-ranging harbor porpoise was 193 sec (Otani, 2000), although most dives were less than one minute in length. The mean dive duration of seven animals in the Bay of Fundy was 65 +/-33 sec (Westgate et al., 1995).

Speed

Mean descent speed was 0.8 m/sec (2.9 km/hr) with a maximum descent speed of 4.3 m/sec (15.5 km/hr). Ascent speeds were similar, with a mean of 0.9 m/sec (3.24 km/hr) and a maximum of 4.1 m/sec (14.5 km/hr) (Otani, 2000). TDR -tagged animals moved at least 51 km in a 24 hr period (2.125 km/hr) (Westgate et al., 1995). A captive harbor porpoise swam between 1 and 2 m/sec (3.6 to 7.2 km/hr) (Curren et al., 1994). A speed range of 2 to 7 km/hr is used in AIM to represent harbor porpoise speed.

Group Size

Off California, the mean group size of harbor porpoise was 5.0 (n=31) (Barlow, 1995).

C-2.3.2.26 Dall's Porpoise (*Phocaenoides dalli*)

Dive Depth

The mean dive depth for tagged Dall's porpoises was 33.4 m (N=17, SD = 23.9) with an absolute deepest dive of 94 m (Hanson and Baird, 1998).

Dive Time

Tagged Dall's porpoises had a mean dive duration of 1.29 min (N=17, SD = 0.84), with a maximum duration of 2.28 min. Therefore, dive times of 1 to 2 min was used in AIM analysis.

Speed

The speed of three behavioral states of Dall's porpoise have been measured in the wild (Law and Blake, 1994) (Table C-9). A shore-based study reported slow rolling speeds of 2.4 to 8.3 km/hr (Jefferson, 1987). Based on these data, a range of 6 to 16 km/hr was used in AIM.

Table C-9. Observed speed states of the Dall's porpoise (Law and Blake, 1994).

Behavior	N	Mean (m/sec) (km/hr)	S.E. (m/sec)	Min (m/sec) (km/hr)	Max (m/sec) (km/hr)
Slow Rolling	4	1.8 (6.48)	0.1	1.6 (5.76)	2.1 (7.56)
Fast Rolling	4	2.6 (9.36)	0.4	1.8 (6.48)	3.4 (12.24)
Rooster-tailing	9	4.3 (15.48)	0.4	3.4 (12.24)	6.0 (21.6)

<u>Group Size</u>

Off California, the mean group size of Dall's porpoise was 3.3 (n=69) (Barlow, 1995).

C-2.3.2.27 Guadalupe Fur Seal (*Arctocephalus galapagoensis*)

<u>Surface Time</u>

The activity budget of lactating females foraging at sea consisted of 73.2% of the time swimming at the surface, 24% of the time diving, and 2.8% of the time resting at the surface.

<u>Dive Depth</u>

Average dive depth of lactating females foraging at sea was 26 ± 14.3 m; median dive depth was 24.5 m; and max dive depth was 115 m, with an average max dive depth of 82 ± 23.7 m (Kooyman and Trillmich, 1986). The frequency distribution of dive depths was about 42% less than 20 m depth (minimum of 5 m depth to be considered a dive), about 50% between 21 and 50 m depth, and about 8% greater than 51 m depth (Kooyman and Trillmich, 1986).

<u>Dive Time</u>

Maximum average duration of dives of lactating females foraging at sea was 4.2 min, maximum dive time ranging from 2.4 to 7.7 min (Kooyman and Trillmich, 1986).

<u>Speed</u>

Estimated velocity based on body size is about 2 m/sec (Gentry et al., 1986).

<u>Habitat</u>

Guadalupe fur seals are the *only Arctocephalus* sp. in the northern hemisphere. They are non-migratory, existing near the equator where tropical conditions are moderated by cool water currents, creating upwelling conditions, most pronounced from June to December (Trillmich, 1986). Throughout the year, however, they are forced to deal with rock surface temperatures that may reach 60°C and sea surface temperatures that never drop below 15°C. Because of the harsh energetic demands, pups suckle until 2 years of age or older (Trillmich, 1986). Lactating females were studied to determine their foraging behavior (Kooyman and Trillmich, 1986). The average distance traveled to feeding areas was 19 km and the average duration of feeding trips was 16.4 hr (ranging from 0.5 to 1.3 days).

C-2.3.2.28 Northern Fur Seal (*Callorhinus ursinus*)

<u>Surface Time</u>

The activity budget during feeding trips of 7 lactating females consisted of diving 26% of the time while at sea and either resting (17%) or swimming (57%) at the surface (Gentry et al., 1986). Between deep dives, the surface time was calculated as 0.8 min, whereas between shallow dives, the surface time was 0.5 min (Goebel et al., 1991).

Dive Depth

Three types of diving patterns: deep dives, shallow dives, and mixed dives. Deep dives (to depths >125 m) occur throughout the day and night and represent foraging dives over the continental shelf (<200 m water depth) to the sea floor. Shallow dives (to depths <75 m) occur primarily at night in areas with deep water depths (Ponganis et al., 1992). Gentry et al. (1986) measured modal dive depths of 50 to 60 m for shallow dives and 175 m for deep dives. Goebel et al. (1991) calculated average dive depths of 36 (± 23) m for shallow dives and 86 (± 26) m for deep dives.

Dive Time

Goebel et al. (1991) calculated average dive durations of 4.1 ± 0.2 min for shallow dives and 7.3 ± 0.5 min for deep dives. This is similar to other measured modal durations of less than 2 min for shallow dives and between 3 and 5 min for deep dives (Ponganis et al., 1992).

Speed

Three females tagged during the winter migration exhibited average traveling speeds of 1.1 to 1.7 km/hr (Baba et al., 2000). During summer foraging trips, mean dive velocities on shallow dives were 1.5 and 1.2 m/sec, and on deep dives 1.8 and 1.5 m/sec (Ponganis et al., 1992). During the winter migration, an overall surface swim speed of 48 (± 12.4) cm/sec (1.7 km/hr) was measured (Ream et al., 2005).

Habitat

The majority of the population of northern fur seals breeds on the Pribilof Islands of Alaska (74%) or the Commander Islands of Russia (17%) (Gentry, 2002). From November to March, they are foraging north of about 35° N; March and April, animals move to continental shelf breaks and begin to migrate north. Pups are mainly born in July, weaned in October or November, and begin southbound migration with rest of population (Gentry, 2002). Animals that breed at San Miguel Island and adult males of all breeding colonies are non-migratory.

C-2.3.2.29 Steller Sea Lion (*Eumetopias jubatus*)

Surface Time

During the summer, adult females spent a mean (± 1 SE) of 23 ± 2.8 hr at sea (50.0 to 58.1% of time) and 19 ± 4.6 hr on land. During the winter, they spent a mean (± 1 SE) of 204 ± 104.6 hr at sea (89.9% of the time).

Dive Depth

Merrick and Loughlin (1997) reported dive depths between 150 and 250 m for adult females in the summer. During the winter maximum dive depths were greater than 250 m. Females with young of the year had shallower dive depths, with a maximum of 72 m.

Dive Time

Merrick and Loughlin (1997) reported maximum dive durations of greater than 8 min for adult females in summer with a maximum of 8 min in winter. The median values were 1.3 and 2.0 min respectively. Adult females with young of the year had a median duration of 1.0 and a maximum greater than 6.0 min.

Speed

Common filter for satellite-linked telemetry data is a maximum swim speed of 10 km/hr, based on the highest documented swim speed + 25% observed during at-sea tracking of sea lions and fur seals (Merrick and Loughlin, 1997). Inter-haulout swim speed (combining times animals are traveling and resting) was estimated at 2.82 ± 0.31 km/hr, with a maximum distance traveled in a 24-h period of 127 km (Raum-Suryan et al., 2004). Ascent rate is similar to descent rate of 1.4 m/sec (Merrick et al., 1994).

Habitat

Steller sea lion pups are born late May – early July, with a peak in June. Pups enter the water 2 to 3 weeks after birth and begin to disperse from the rookery when 2 to 3 months old, traveling up to 120 km (Raum-Suryan et al., 2004). Adults remain within 500 km of their natal rookery (Raum-Suryan et al., 2002). Like other otariids, Steller sea lions spend their time at sea either at the surface resting and traveling, or diving to capture prey (Merrick and Loughlin, 1997). During the summer, adult females stayed on the continental shelf for most foraging trips, whereas two of the five winter adult females transited directly to the seamounts in the center of the Gulf of Alaska and spent long periods foraging over water depths greater than 2 km (Merrick and Loughlin, 1997).

C-2.3.2.30 California Sea Lion (*Zalophus californianus*)

Surface Time

California sea lions exhibit three behavior states during average foraging trips that last 52.8 ± 24.5 hr (mean ± SD): diving in bouts (mean duration 3.3 ± 1.5 hr), swimming between bouts (mean duration 2.2 ± 3.1 hr), and resting at the surface (mean duration 0.4 ± 0.7 hr) (Feldkamp et al., 1989). During the duration of a foraging trip, 32.7 ± 12.6% of time diving in bouts, 22.8% of time at surface between dives in dive bouts, 41.4 ± 18.0% of time swimming between dive bouts, and 3.1 ± 3.1% of time resting on surface (Feldkamp et al., 1989). Dive bouts are broken into actual diving (32.7 ± 12.6% of the time, performing 16.4 ± 3.1 dives/hr) and surface time between dives (22.8% of the time). A recent study comparing diving behavior in normal and El Niño years found that during normal years surface intervals were short (mean = 1.5, S.E. = 0.9 min), while during El Niño years, the sea lions had to swim farther offshore and had significantly longer surface intervals (mean =2.5, S.E.= 0.8 min) (Weise et al., 2006).

Dive Depth

96% of dives of breeding females are between 8 and 75 m (Melin and DeLong, 1999). Average mean dive depth 61.76 ± 44.13 m, average max dive depth of 224.1 m for 10 breeding females (Feldkamp et al., 1989). A recent study comparing diving behavior in normal and El Nino years found that during normal years, California sea lions dove primarily on the continental shelf to shallow depths (mean = 33 m, S.E. = 37m) (Weise et al., 2006).

Dive Time

92% of dives of breeding females are less than 4 min in duration (Melin and DeLong, 1999). Average mean duration 2.07 ± 1.27 min, average max duration 7.71 min for 10 breeding females (Feldkamp et al., 1989). During “normal” years the dive duration of California sea lions had a mean duration of 1.9 min (S.E. = 1.6 min) (Weise et al., 2006).

Speed

Mean estimated swim velocity of 9 km/hr (Feldkamp et al., 1989). This is consistent with the measured swim velocity of Galapagos sea lions (*Zalophus wollebaeki*) in a laboratory setting (Gentry et al., 1986).

Habitat

California sea lions congregate to pup and breed primarily at San Miguel and San Nicolas islands in the Channel Islands, California (Stewart and Yochem, 1999). Females pup from May to June and breed in July. During the breeding season, adult males establish territories, fasting for 1 to 45 days in order to maintain their territory. Males that cannot establish territories retreat to nearshore waters or to “bachelor” beaches nearby (Heath, 2002). During breeding and while suckling their pups, female California sea lions alternate 2- to 3-day at-sea foraging trips with 1- to 2-day nursing visits on land. From August to May, all age classes except lactating females and their pups migrate to central and northern California, Oregon, Washington, and British Columbia (Stewart and Yochem, 1999).

Group Size

California sea lions aggregate in large groups ashore, and may travel at sea in groups of a dozen or more (Reeves et al., 2002).

C-2.3.2.31 Hawaiian Monk Seal (*Monachus schauinslandi*)

Dive Depth

Monk seals were observed to dive between 50 and 500 m (Parrish et al., 2002). The overwhelming majority of the foraging dives recorded with an animal-mounted video recorder were to 50 to 60 m in depth (Parrish et al., 2000).

Dive Time

Maximum dive times of 12 min were observed (Neves, 1998).

Speed

No swim speeds have been reported for Hawaiian monk seals. Therefore, the 2.35 m/sec (9 km/hr) value for harbor seals was used (Lesage et al., 1999).

Habitat

Hawaiian monk seals are found primarily on the Hawaiian leeward islands north of Kaua‘i, although they are occasionally seen on the main islands. They haul out on the shores and return to the water to feed. Their atoll habitat makes deepwater available close to shore, and they are known to dive to the bottom in at least 500 m of water.

Group Size

Hawaiian monk seals are solitary, except for mothers and calves (Reeves et al., 2002).

C-2.3.2.32 Northern Elephant Seal (*Mirounga angustirostris*)

Surface Time

Surface times reported for northern elephant seals include: 2 min (Burgess et al., 1998); 2.8 ± 0.5 min (Le Boeuf et al., 1988); average mean surface interval 2.37 min (Le Boeuf et al., 1989). For post-breeding females mean surface interval is 2.1 ± 0.5 min; for pregnant females mean surface interval is 2.1 ± 0.6 min; and for adult males mean surface interval is 2.7 ± 0.9 min (Le Boeuf, 1994).

Dive Depth

Average dive depths for northern elephant seals have been reported as 900 m (Burgess et al., 1998). Modal dive depths are 500 to 700 m, mean 504 ± 125 m, and average max 1031 m (Le Boeuf et al., 1989). Also, modal dive depths of 350 to 650 m, mean 400 ± 156 m, and max 822 ± 76 m have also been reported (Higgins et al., 1988). Post-breeding migration dive depths have been reported for males at 366 ± 37.5 m and for, females at 522 ± 26.8 m. Post-molt migration dive depths have been reported for males at 366 ± 57.5 m and females at 486 ± 49.1 m (Stewart and DeLong, 1995). Post-breeding females max dive depth is 1273 m, mean 509 ± 147 m; pregnant females max dive depth is 1181 m, mean 473 ± 151 m; and adult males max dive depth is 1503 m, mean 330 ± 127 m (Le Boeuf, 1994).

Dive Time

Dive times are 10 to 20 min (Burgess et al., 1998). Mean dive duration are reported at 19.2 ± 4.3 min, max duration 37.4 ± 6.3 min (Le Boeuf et al., 1988) and at 19.95 ± 4.3 min, average max 46.6 min (Le Boeuf et al., 1989). Post-breeding migration are reported for males at 22.4 ± 1.7 min and for females at 21.8 ± 1.0 min. Postmolt migrationare reported for males at 23.8 ± 2.3 min and females at 24.5 ± 2.4 min (Stewart and DeLong, 1995). Post-breeding max dive duration are reported for females at 47.5 min, mean

20.8 ± 4.1 min; for pregnant females at 67.9 min, mean 27.7 ± 6.4 min; and adult males at 66.7 min, mean 21.2 ± 4.6 min (Le Boeuf, 1994).

Speed

Descent rate of 1.1 ± 0.1 m/sec and ascent rate of 1.0 ± 0.2 m/sec have been reported (Williams et al., 2000). Mean daily transit rates were 0.65 ± 0.11 m/sec (2.3 km/hr) in 1998 (El Niño year) not statistically different from non-El Niño years at 0.71 ± 0.23 m/sec (2.6 km/hr) (Crocker et al., 2006). Rates of travel for post-breeding migration females are 91 ± 16 km/day, for post-breeding migration males are 103 ± 90 km/day, post-molt migration females are 73 ± 12 km/day, and post-molt males are 90 ± 16 km/day (Stewart and DeLong, 1995). Velocity on descent 1.5 m/sec except for second descent segment of Type C dives was 0.59 m/sec; velocity on bottom and ascent averaged 1.0 m/sec (Crocker et al., 1994). Descent angles were 30° to 56° with ascent angles of 52° to 82° (Crocker et al., 1994).

Habitat

Individuals return to the same foraging areas during post-breeding and post-molting movements (Stewart and DeLong, 1995). Seals dive continually to depths of 250 to 550 m during both migrations and traveled linear distances of at least 18,000 km (females) to 21,000 km (males) during the 250 days (males) to 300 days (females) they were at sea (Stewart and DeLong, 1995). Adult males migrated farther north and fed off Alaska along the continental margins during the post-breeding and post-molt migrations, whereas females foraged farther south and out in the open ocean of the central Pacific (Le Boeuf, 1994, Stewart and DeLong, 1995). All seals traveled north immediately upon entering the water, traveling 90 to 100 km/d (1.04 to 1.15 m/sec) for 16 ± 7.6 days (females) to 38 ± 5.7 days (males). Then travel speeds slowed and animals remained in somewhat more defined geographic areas for 36 ± 5.2 days (females) and 51 ± 6.4 days (males) where average distance covered was less than 32 km over 3 or more consecutive days.

Group Size

Elephant seals at sea are presumably solitary (Reeves et al., 2002).

C-2.3.2.33 Harbor Seal (*Phoca vitulina*)

Surface Time

Harbor seals dive in bouts. Adult females spend 44.6 ± 4.68% of their time hauled out on land and 55.4 ± 4.68% of time at sea. While at sea, they spend 8.9 ± 2.89% of time diving (Bowen et al., 1999). Five different dive types yield surface intervals of: 42.6 ± 23.5 s, 43.8 ± 60.7, 40.2 ± 31.0 s, 38.6 ± 34.8 s, 44.8 ± 31.9 s (Lesage et al., 1999)

Dive Depth

Approximately 50% of dives are shallower than 40 m, while 95% of dives are shallower than 250 m (Gjertz et al., 2001). Most dives (40 to 80%) were < 20 m, though dives from 50 to 150 m were not uncommon and dives to 508 m were recorded (Hastings et al., 2004). For 20 lactating females mean dive depth is 11.3 ± 0.83 m (Bowen et al., 1999). Five different dive types yielded dive depths of: 19.6 ± 5.8 m, 5.8 ± 2.8 m, 7.8 ± 2.7 m, 7.9 ± 2.7 m, and 12.2 ± 7.2 m (Lesage et al., 1999). Harbor seals in Monterey Bay had an absolute maximum dive depth of 481 m, while median dive depths were between 5 and 100 m (Eguchi and Harvey, 2005).

Dive Time

Mean dive durations for individual seals (14 females and 11 males) ranged from 46 s to 2.9 min with a high proportion of dives being less than 2 min; max duration was 31 min (Ries et al., 1997). Approximately 50% of dives lasted 2 to 4 min, 90% lasted less than 7 min, and 97% less than 10 min

(Gjertz et al., 2001). Most dives were < 4 min in duration (Hastings et al., 2004). For 20 lactating females: mean dive duration was 1.6 ± 0.09 min (Bowen et al., 1999). Five different dive types yielded dive durations of: 135.7 ± 37.5 s, 40.1 ± 29.8 s, 122.4 ± 50.9 s, 142.3 ± 52.9 s, 167.9 ± 80.1 s (Lesage et al., 1999).

Speed

For 20 lactating females mean ascent rate is 0.6 ± 0.03 m/sec and mean descent rate is 0.6 ± 0.03 m/sec (Bowen et al., 1999). Five different dive types yielded: median swim speed (bottom) of: 1.00 ± 0.47 m/sec, 0.47 ± 0.56 m/sec, 1.21 ± 0.44 m/sec, 0.68 ± 0.40 m/sec, 0.15 ± 0.25 m/sec (Lesage et al., 1999). Five different dive types yielded angles of ascent (deg) of 70.0 ± 27.8, 59.0 ± 33.6, 48.0 ± 29.3, 31.2 ± 26.8, 75.9 ±24.1 (Lesage et al., 1999). Five different dive types yielded angles of descent (deg) of 63.6 ± 29.8, 59.8 ± 34.4, 32.1 ± 28.9, 64.0 ± 28.6, 71.8 ±27.4 (Lesage et al., 1999).

Habitat

Animals may move among different haul-out sites or among favored haul-out sites and foraging areas, but these are usually less than 50 km apart (Gjertz et al., 2001). Harbor seals are generally considered to feed close to the seafloor at depths between 4 to 200 m (Gjertz et al., 2001). Five different dive types have been identified (Lesage et al., 1999).

Group Size

Harbor seals are solitary at sea (Reeves et al., 2002).

C-2.3.3 Acoustic Propagation Modeling

C-2.3.3.1 Sound Source Waypoints

Each modeled site in an operating area (OPAREA) is defined by a latitude and longitude with the source ship driving a triangular pattern[6] (Figure C-12). The site position was used as the location of the center of the triangle (as opposed, e.g., to using the site position as the starting point). For input into AIM, a MATLAB subroutine was created to determine the waypoints as a function of time. The input parameters for the subroutine were latitude and longitude of the site, ship speed, number of hours following a bearing, duration of operation, and source depth. The output of the subroutine was a file of waypoints (latitude, longitude, course, depth of source, and leg duration [minutes

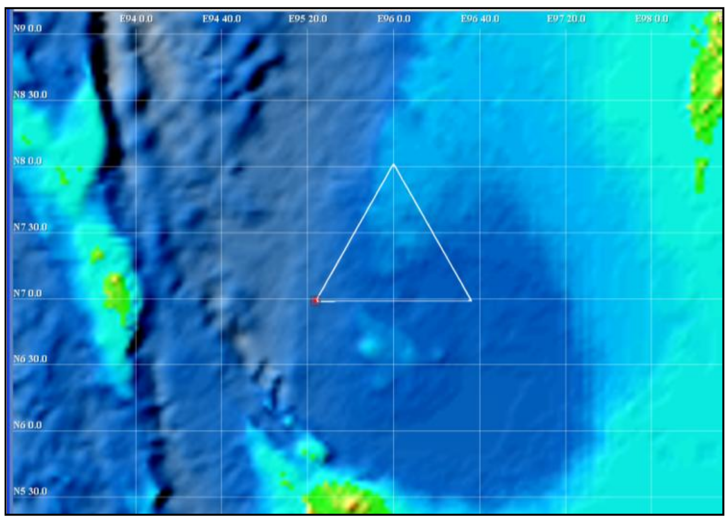


Figure C-12. Pattern driven by source ship for OPAREA 17, which is defined at 7.5°N and 96°E for latitude and longitude, respectively.

6 The SURTASS LFA sonar vessel almost always operates in a racetrack or triangular geometry, which optimizes the LFA system coverage, while accounting for the slow vessel speed (nominally only 3 kts) and the need to minimize the number of vessel turns (when the SURTASS array is not straight and therefore unable to accurately process sonar echoes).

on heading]) for use in AIM (Table C-10). To take into account the curvature of the earth, spherical trigonometry was used to find the triangular height, and the approximation: 1º longitude = 60 × Cosine of latitude was used to correct the longitude values for a given latitude. For all modeled sites, the ship speed was 4 kts, and in all cases the time on each bearing was 8 hours (480 min). The overall duration of the mission in each OPAREA was 7 days.

C-2.3.3.2 Transmission Loss and Modeling Area

To model the sound fields created by the SURTASS LFA sonar source, the Navy standard parabolic equation (PE) model was used. PE was chosen for four reasons: 1) historically it has been the model used for AIM analysis of low frequency (LF) sources in the FOEIS/EIS (DoN, 2001) and FSEIS (DoN, 2007a); 2) this model has been tested by the U.S. Navy and has adequate performance for the frequencies and range of depths examined in this analysis; 3) its resolution of TL in depth and range from the source is adequate; and 4) it is compatible with the supporting databases that were used. PE is integrated into AIM and a number of parameters may be specified. The bathymetry used was the 2-minute Gridded Global Relief Data set (U.S. DoC, ETOPO2v2) from the National Geophysical Data Center (NGDC). The sound velocity profiles for each location and season were obtained from Generalized Digital Environmental Model (GDEM) (OAML, 2000), a standard U.S. Navy database. A wind speed of 15 knots was used to calculate surface losses using the Bechmann-Spezzichino formula modified by Leibiger (1978). For bottom loss, province 5 and curve 5 from the consolidated bottom loss upgrade (CBLUG) database (OAML, 2000) were used for all sites. Four bearings were modeled per location and a nominal vertical half-beam width of 45 degrees was used. Spherical spreading was assumed within 0.1 km of the source.

The LFA source was modeled as a vertical line array using the actual LFA element spacing, transmitting at a nominal frequency and nominal source level. For this modeling effort a single frequency of 300 Hz (i.e., the middle of the 100 to 500 Hz band of the system), and an individual element source level of 215 dB re 1 μPa @ 1 m (rms) (SPL) (or an array source level of about 227.5 dB re 1 μPa @ 1 m (rms) (SPL) in the far-field) were used as these nominal values. To determine the range extent for the PE model, an initial run with a range of 1,000 km was conducted. The distance at which the TL became at least 100 dB was determined. This number was used as the radial extent for calculating TL in the PE model. Thus, essentially the modeled area included all received levels down to about 128 dB re 1 μPa (rms) (SPL). Note that this does not cover the entire range of the risk continuum but the risk for SPL of 128 dB is about 0.000008%, and it represents a negligible contribution to the overall risk calculation. To finalize the boundaries of the simulation area and to populate the area with animats, approximately 100 km was added to the radial extent determined for the PE model so that source movement could be accounted for. AIM was set to recalculate the TL after the source had moved for 5 min in distance (Table C-11).

C-2.4 RESULTS OF AIM MODELING

C-2.4.1 ANIMAT EXPOSURE HISTORIES

AIM simulations create a realistic animal movement track for each animat and are based on the best available animal behavioral data. Collectively, the animat tracks derived for each simulation (area/species combination) are representative of the movements of animals in the population under consideration. Within AIM, the acoustic sound field for each source was also determined and convolved with the animat tracks so that the output of AIM is the time history of exposure for each animat. The cumulative energy was calculated as a ‘single ping equivalent’ (SPE) and used as input to the risk continuum function (described below) in order to assess the potential risk of MMPA Level B harassment.

Table C-10. SURTASS LFA sonar source waypoints for OPAREA 17.

LATITUDE (DEGREES NORTH)	LONGITUDE (DEGREES EAST)	COURSE (° T)	SOURCE DEPTH (M)	LEG DURATION (HOURS)
6.980375	95.395519	090	120	8
6.980375	96.604480	330	120	8
8.019624	96.000000	210	120	8
6.980375	95.395519	090	120	8
6.980375	96.604480	330	120	8
8.019624	96.000000	210	120	8
6.980375	95.395519	090	120	8
6.980375	96.604480	330	120	8
8.019624	96.000000	210	120	8
6.980375	95.395519	090	120	8
6.980375	96.604480	330	120	8
8.019624	96.000000	210	120	8
6.980375	95.395519	090	120	8
6.980375	96.604480	330	120	8
8.019624	96.000000	210	120	8
6.980375	95.395519	090	120	8
6.980375	96.604480	330	120	8
8.019624	96.000000	210	120	8
6.980375	95.395519	090	120	8
6.980375	96.604480	330	120	8
8.019624	96.000000	210	120	8
6.980375	95.395519	090	120	8
6.980375	96.604480	330	120	8
8.019624	96.000000	210	120	8

Table C-11. Acoustically modeled SURTASS LFA sonar OPAREAs.

OPAREA	Simulation Area Boundaries				PE Radius (km)	Number of Animats (approx.)
	North	South	East	West		
1	42.0° N	34.0° N	152.0° E	144.0° E	500	60,000
2	32.0° N	26.0° N	139.0° E	133.0° E	500	40,000
3	24.0° N	18.0° N	128.0° E	122.0° E	1000	40,000
4	12.5° N	8.5° N	147.0° E	143.0° E	350	20,000
5	42.0° N	35.5° N	135.0° E	128.5° E	450	35,000
6	27.0° N	24.5° N	126.5° E	123.0° E	250	10,000
7	24.0° N	19.0° N	121.0° E	117.0° E	300	15,000
8	35.5° N	25.5° N	171.0° E	159.0° E	600	60,000
9	18.0° N	12.0° N	168.0° E	161.5° E	300	45,000
10	28.5° N	22.0° N	154.5° W	165.0° W	500	35,000
11	21.5° N	17.0° N	156.0° W	162.0° W	300	30,000
12	34.5° N	28.0° N	117.0° W	124.5° W	500	45,000
13	32.5° N	27.5° N	74.0° W	80.5° W	400	30,000
14	61.5° N	50.5° N	7.5° W	20.0° W	600	40,000
15	44.5° N	37.0° N	10.0° E	3.5° E	650	35,000
16	23.0° N	15.75° N	68.5° E	61.0° E	400	30,000
17	9.0° N	5.5° N	94.0° E	97.5° E	300	15,000
18	7.0° N	2.0° N	79.0° W	85.0° W	400	35,000
19	2.75° S	19.0° S	161.5° E	150.0° E	600	65,000

C-2.5 BIOLOGICAL RISK AND DETERMINATION OF RISK FUNCTION

<u>Reiteration of Risk Analysis Process from the FOEIS/EIS (DoN, 2001)</u>

For the convenience of the reader, Sections C-2.5 through C-2.84 in this document have been duplicated from the FOEIS/EIS (DoN, 2001) and included here. These sections originally appear in that document as Subchapters 4.3.2 through 4.3.6.4 and 4.3.7.5. The pertinent changes made to them here were to: a) remove internal references to other chapters/subchapters of the original FOEIS/EIS to improve readability; b) correct references to include figures and tables to be consistent with this appendix: c) add reference units (if omitted) where dB units are used: d) correct other minor grammar or spelling, as discovered, or due to the editing just described, and e) provide updated or additional data/information where appropriate to assist in reader understanding.

Over the last ten years, AIM capability has been constantly upgraded and improved. This, and the advancements in computer technology, have allowed a greatly improved and expanded AIM functionality. As an example, the original AIM needed to "seed" the animats in gridded areas of the ocean, while the latest version allows you to select various areas graphically and seed different densities to better conform to the published science for that species.

To determine the potential impacts that exposure to LF sound from SURTASS LFA sonar operations could have on marine mammals, biological risk standards were defined with associated parameters of exposure. Based on the MMPA, the potential for biological risk was defined as the probability for injury or behavioral harassment of marine mammals. In this analysis, behavioral harassment is assumed to be a significant change in a biologically important behavior, which is consistent with the National Research Council's characterization (NRC, 2000). The potential for biological risk is a function of an animal's exposure to a sound that would potentially cause hearing, behavioral, psychological or physiological effects. The measurement parameters for determining exposure were RL in decibels, length of the signal (ping), and number of pings received.

This analysis of risk is an alternative to the use of all-or-nothing thresholds. The subsequent discussion of the risk function emphasizes the advantages of a smoothly varying model of biological risk in relation to sound exposure. However, for the purpose of the SURTASS LFA sonar analyses presented in this SEIS/SOEIS, all marine mammals exposed to RLs $\geq$180 dB SPE are evaluated as if they are injured.

When SURTASS LFA sonar transmits, there is a boundary that encloses a volume of RLs at or above 180 dB re 1 µPa (rms) (SPL), and a volume outside this boundary that experiences RLs below 180 dB re 1 µPa (rms) (SPL). In this analysis, the 180-dB re 1 µPa (rms) (SPL) figure is emphasized because the level of risk for marine mammals depends on their location in relation to the LFA mitigation zone.

Before the biological risk standards could be applied to realistic SURTASS LFA sonar operational scenarios, two factors had to be considered, which resulted in the development of the risk continuum approach. In assessing the potential risk of significant change in a biologically important behavior, two questions must be resolved:

How does risk vary with repeated exposure?
How does risk vary with RL?

These questions have been addressed by the use of a function that translates the history of repeated exposures (as calculated in the Acoustic Integration Model) into an equivalent RL for a single exposure with a comparable risk. This approach is similar to those adopted by previous studies of risk to human hearing (Richardson et al., 1995b; Crocker, 1997).

SPL and SPE

- For the acoustic modeling, the LFA source was modeled as a point source, with an effective source level (SL) in dB re 1 µPa @ 1 m (SPL), a 60 sec duration signal, and a beam pattern that was correct for the number and spacing of the individual source elements. This source model, when convolved with the three dimensional transmission loss (TL) field generated by the PE propagation model, defines the received level RL (in SPL) field surrounding the source for a 60 sec LFA signal. These RLs for each modeled location and for any animats at that location are then recorded in the exposure history of each animat and used to generate its SPE value. Therefore, SPE values are a function of SPL, not SEL.
- The 180 dB SPE previously identified as the onset of injury includes the volume containing the 180 dB re 1 µPa (rms) (SPL) isopleth, but it also extends beyond it due to the multiple transmissions included during the SPE calculation. Additionally, due to ship and animal movement and the depth of the source, it is highly unlikely that any animal would be within the 180 dB re 1 µPa (rms) (SPL) isopleth for more than a single transmission, so this isopleth is a valuable reference, which can be used to estimate the SPE for a single transmission. Thus, the 180 dB re 1 µPa (rms) (SPL) isopleth is a reasonable volume for minimizing injury to marine mammals during operations, and the 180 dB SPE calculation used to estimate injury in the impact calculations below is a conservative threshold which includes acoustic energy from all of the transmissions of the entire operation.
- The following is the equation for SPE as a function of SPL:

$$SPE = 5 \times Log_{10}\left(\sum_{n}\left(10^{(P_N/10)}\right)^2\right)$$

Where:

SPE is the Single Ping Equivalent of the N received transmissions at the animal,

N is the number of received transmissions at the animal, and

P_N is the received level or pressure in dB re 1 µPa, (i.e., an SPL value) at the animal for each received transmission.

C-2.5.1 EFFECTS OF REPEATED EXPOSURE

The human model provides the most extensive data and is presently the best objective foundation for an assessment of repeated exposure. Long term hearing loss in humans is accelerated by chronic daily 8-hour workplace exposure (over time scales on the order of tens of years) to sounds at levels of 85 dB(A) re 20 μPa (A-weighted; i.e., <u>in air</u>) or greater (Guide for Conservation of Hearing in Noise, American Academy of Ophthalmology and Otolaryngology, 1969; Ward, 1997). The sound power reference unit dB(A) is the accepted convention for frequency-weighted measure of hearing in humans. In young healthy humans, 0 dB(A) is the nominal threshold of best hearing, and measured free-field thresholds for the frequencies of best binaural hearing (400 to 8,000 Hz) vary between –10 to + 10 dB re 20 μPa (Beranek, 1954; Harris, 1998), depending on measurement objective and technique used.

It is intuitive to assume that the effects of exposure to multiple LF sounds would be greater than the effects of exposure to a single sound. A formula is needed to address the potential for accumulation of effects over a 7 to 20-day period (estimated maximum SURTASS LFA sonar mission period), allowing for varying RLs and a duty cycle of 20 percent or less. There are no published data on marine mammals regarding responses to repeated exposure to LF sound. Two lines of evidence from human studies were used to devise a plausible formula.

Richardson et al. (1995b), citing Kryter et al. (1966), discusses workplace damage risk criteria relative to exposure to continuous narrowband (one-third octave) noise. To relate to workplace data, note that during an 8-hour exposure during normal SURTASS LFA sonar operations, the pings would add up to a total of 48 to 96 min of LF sound transmission. The workplace damage risk criteria change from 88 dB to 82 dB to 80 dB re 20 μPa SPL, as the duration of exposure changes from 8 to 2 hours to 30 min. These changes indicate that the effects of increased exposure are not constant across this range of durations. When continuous exposure increases from 30 min to 2 hr per day, the effect scales with $10 \log_{10}(T)$. When continuous exposure increases from 2 to 8 hr per day, the effect scales with $3.3 \log_{10}(T)$. These values do not account for the probable reduction of effect due to the long intervals between SURTASS LFA sonar pings.

The second line of evidence comes from repeated exposure to impulsive sounds. Richardson et al. (1995b), citing Kryter (1985) and Ward (1968), discussed the relationship between repeated exposures of the human ear to impulsive sound and a TTS in the subject's hearing. The risk threshold is lowered by 5 dB per ten-fold increase in the number of pulses per exposure if the number of pulses per exposure is less than 100. These findings are consistent with qualitative statements by Crocker (1997). Following this logic, if a ping of level L (in dB SPL) is repeated N times, the SPE level is defined as $L + 5 \log_{10}(N)$ in dB SPE. For example, using this formula, 100 pings at RL 170 dB re 1 μPa (rms) (SPL) are equivalent to one ping at 180 dB SPE.

Due to the lack of information on behavioral responses, the $5 \log_{10}(N)$ formula has been chosen for assessing the risk to a marine mammal for significant change in a biologically important behavior due to repeated exposures to LF sound such as SURTASS LFA sonar transmissions. In 2001, at the time of the initial FOEIS/EIS, this was true, especially for operations lasting up to 20 days, and for the most part it is still true today. There are no scientific reports, beyond the Low Frequency Sound Scientific Research Program (LFS SRP) data discussed below, that have reported on LF signals and behavior, especially for smaller cetaceans that have reduced hearing sensitivity at low frequencies. Additionally, at the time of the FOEIS/EIS, there were no reports on how TTS grew with increased signal duration or frequency of transmission. The following provides some mathematical details of how the $5 \log_{10}(N)$ factor was implemented for repeated exposure to varying levels:

- For each animal in the AIM simulation, the RL of each ping was calculated as the animal moved in relation to the sound source;
- These RLs were converted into raw acoustic intensities (proportional to the intensity of the signal, or the variance of the waveform);
- To correctly summarize the intensities, their values were squared and summed together; and
- This sum was converted back to an equivalent dB value by taking the base 10 logarithm of the sum, and multiplying it by 5.

In this process, an SPE RL is larger than the maximum SPL RL of any single ping in a sequence (see text box below). Also, the SPE for a sequence consisting of a single loud ping and a long series of much softer pings is almost the same as the level of the single loud ping. A ping duration (length) of 60 sec was assumed in the modeling and risk assessment calculations using SPE. The adoption of 60 sec and 20% as the standard ping duration and duty cycle respectively, for calculations in the FOEIS/EIS, provides a reasonable estimate of the potential for effects from real-world operations without sacrificing the conservative nature of the analysis process. (The current duty cycle is nominally 7.5 to 10.0%: thus, the FOEIS/EIS modeling that was done at higher duty cycles must be considered conservative.)

Sample Single Ping Equivalent (SPE) and Risk Examples

A generic example to illustrate the calculations used for translating the number of pings into an SPE is shown in Figure C-13a. This illustration assumes a marine mammal is exposed to a total of ten SURTASS LFA sonar transmissions, or pings, at received levels (RL) between 150-159 dB re 1 µPa (rms) (SPL). The pings are delineated by individual bins of one dB each. The example illustration shows that the animal was exposed to two pings at RL 150 dB re 1 µPa (rms) (SPL), none at RL 151 dB re 1 µPa (rms) (SPL), three pings at RL 152 dB re 1 µPa (rms) (SPL), etc. To arrive at a total SPE for the entire exposure, the intensity level for each ping is first calculated (i.e., 1×10^{15} µPa for each of the two 150 dB RL exposures, 1.58×10^{15} µPa for each of three 152 dB RL exposures, etc). These intensity values are then squared and added together. Taking 5 $\log_{10}$ of this sum of the squared intensities (1.24×10^{32}) results in a total of 160.47 dB SPE.

An example of the effect of increased RL can be seen in Figure C-13b, which displays the probability function for a single ping. At an RL of 150 dB SPE, the risk of significant change in a biologically important behavior is 2.5%. The RL corresponding to 50% risk on this curve is 165 dB SPE. At 180 dB SPE, the risk of significant change in a biologically important behavior is 95%. For the above SPE example, the risk function would predict a 24.48% probability of significant change in a biologically important behavior.

1

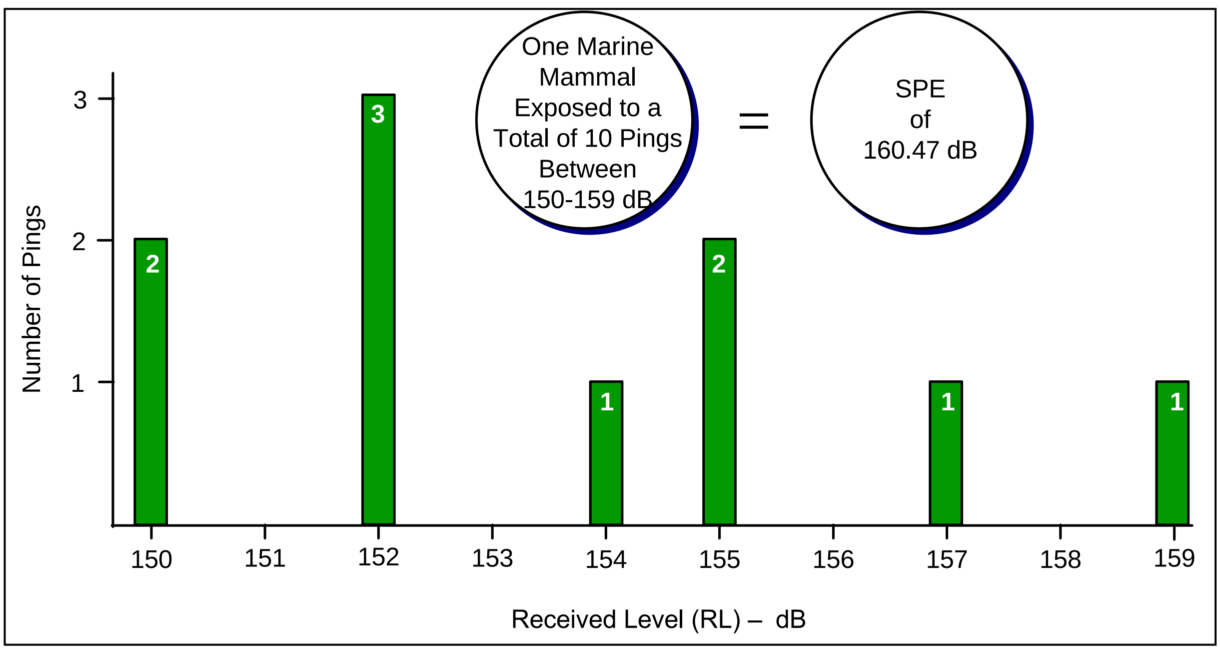


Figure C-13a. Sample single ping equivalent (SPE) calculation.

2

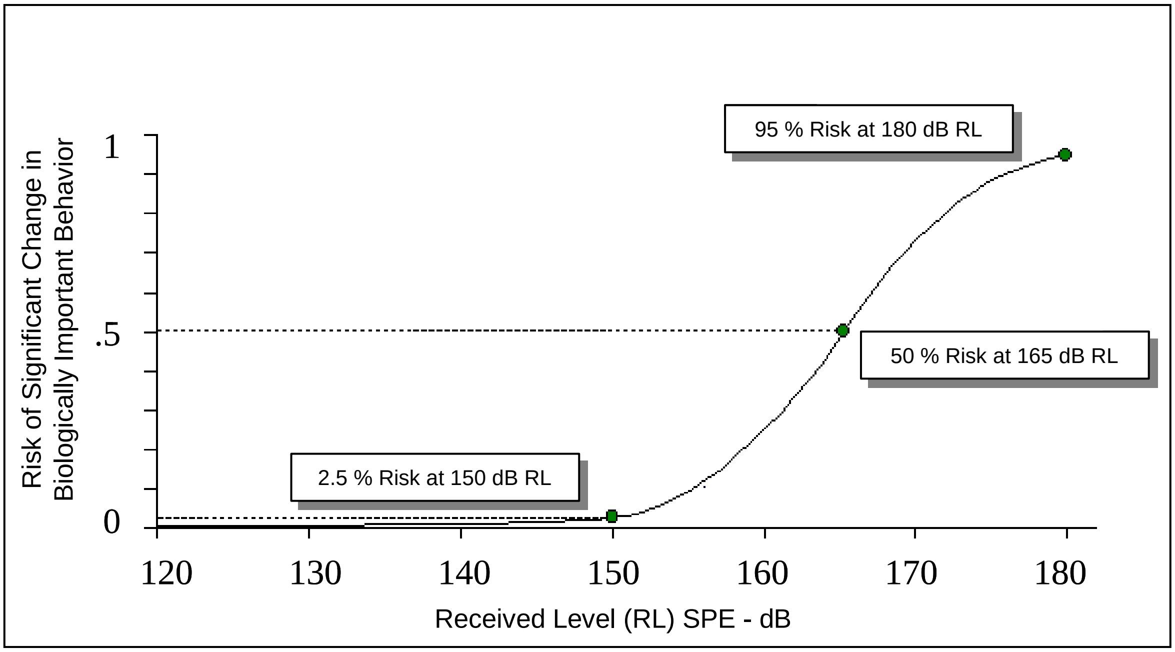


Figure C-13b. Single ping equivalent risk function.

C-2.5.2 DETERMINATION OF RISK FUNCTION

Prior to the research and analyses documented in the FOEIS/EIS (DoN, 2001), the definition of biological risk to marine mammals had generally been based on a received sound level threshold for individual species. For example, 120 dB re 1 µPa (rms) (SPL) has been used as a threshold for behavioral modification (NRC, 1994). However, this approach set a discrete threshold below which any RL value was considered risk-free, and any value above it had been considered certain to cause responses by marine mammals. Nonetheless, it was unreasonable to assume that in a large animal stock a one decibel RL increase (say, from 119 to 120 dB re 1 µPa (rms) (SPL)) would cause a change from no behavioral response to all animals in the stock responding. Additionally, note that the LFA use of an SPE for this basement value is conservative because it is adding the potential impact of many signals, not just the loudest received.

The widely adopted approach used in the FOEIS/EIS to assess biological risk was a smooth, continuous function that mapped RL to risk. Scientifically, this acknowledges that individuals may vary in responsiveness. Mathematically, this eliminated the possibility for dramatic changes in estimated impact as a result of small changes in parameter values. As a result, the potential for misleading results was greatly reduced. These were the reasons for developing the risk continuum.

To represent a probability of risk, the function should have a value near zero at very low exposures, and a value near one for very high exposures. One class of functions that satisfied this criterion was cumulative probability distributions, or cumulative distribution functions (CDFs). In selecting a particular functional expression for risk, several criteria were identified:

- The function must use parameters to focus discussion on regions of uncertainty;
- The function should contain a limited number of parameters;
- The function should be capable of accurately fitting experimental data; and
- The function should be reasonably convenient for algebraic manipulations.

The function used here is adapted from the solution in Feller (1968):

$$R = \frac{1-\left(\frac{L-B}{K}\right)^{-A}}{1-\left(\frac{L-B}{K}\right)^{-2A}}$$

Where: R = risk (0-1.0);

L = RL in dB SPE;

B = basement RL in dB SPE, below which risk is negligible (119 dB SPE);

K = the RL increment above basement in dB at which there is 50% risk (46 dB); and

A = risk transition sharpness parameter (10).

In order to use this function, the values of the three parameters (B, K, and A) need to be established. The values used in the FOEIS/EIS (DoN, 2001) analysis were based on the results of the 1997 to 1998 LFS SRP. Prior to the LFS SRP, a 50% probability of avoidance might have been associated with a RL of 120 dB re 1 μPa (rms) (SPL) (Malme et al., 1983, 1984). It was also hypothesized, prior to the LFS SRP, that marine mammals exposed to RLs near 140 dB re 1 μPa (rms) (SPL) would depart the area (e.g., Richardson et al., 1995b). It was critical, therefore, to examine the logic that motivated the selection of experiments for the LFS SRP, how those results related to earlier data, and how the LFS SRP results related to the development of the risk continuum.

C-2.6 LOW FREQUENCY SOUND SCIENTIFIC RESEARCH PROGRAM (LFS SRP)

In 1997, there was a widespread consensus that cetacean response to LF sound signals needed to be better defined using controlled experiments. In response, the Navy worked with scientists to develop the LFS SRP. The LFS SRP was designed to supplement the data from previous studies. Also, the Navy made the SURTASS LFA sonar vessel (R/V *Cory Chouest*) available to the LFS SRP, which enabled greater control over RL due to the dynamic range of the ship's transmission system and the quality of its environmental acoustic modeling capabilities. Logistical constraints limited the experimental use of the SURTASS LFA sonar to the North Pacific.

C-2.6.1 PREVIOUS STUDIES

Prior to the LFS SRP, the best information regarding whale responses to continuous, LF, anthropogenic noise was summarized by Richardson et al. (1995b):

> "Some marine mammals tolerate, at least for a few hours, continuous sound at received levels above 120 dB re 1 μPa (rms). However, others exhibit avoidance when the noise level reaches ~120 dB (re 1 μPa [rms] [SPL]). It is doubtful that many marine mammals would remain for long in areas where received levels of continuous underwater noise are 140+ dB (re 1 μPa [rms] [SPL]) at frequencies to which the animals are most sensitive."

There have been several studies that have demonstrated responses of marine mammals to exposure levels ranging from detection threshold to 120 dB re 1 μPa (rms) (SPL):

- One study examined responses of gray whales migrating along the California coast to various sound sources located in their migration corridor (Malme et al., 1983, 1984). Gray whales showed statistically significant responses to four different underwater playbacks of continuous sound at RLs of approximately 120 dB re 1 μPa (rms) (SPL). The sources of the playbacks were typical of a drillship, semisubmersible, drilling platform, and production platform. This study was replicated in Phase II of the LFS SRP using SURTASS LFA sonar stimuli. However, the Phase II research demonstrated that it may be invalid to apply the inshore (2 km [1.1 nmi] from shore) response model (when 50 percent of the whales avoided SURTASS LFA sonar stimuli at RL of 141 ±3 dB re 1 µPa [rms] [SPL]) to sources that were offshore (4 km [2.2 nmi] from shore) of migrating whales where the whales did not avoid offshore sources at RLs of 140 dB re 1 µPa (rms) (SPL).

- Two other studies concern Arctic animals. Belugas (white whales) and narwhals showed behavioral responses to noise from an icebreaker at 50 km (27 nmi). At this range, the RL of the noise is near the detection threshold. Richardson et al. (1995b) point out that the strong reactions to icebreaker noise are unique in the marine mammal disturbance literature. These reactions appeared similar to the responses of each species to their most significant predator, the killer whale (Finley et al., 1990). It is not known why these animals were so sensitive to icebreaker noise and responded as if it were a predator. But, if these animals are responding to ice breakers as if to predators, it was understandable why these animals would show strong responses at detection threshold. This response has not been noted for other sound stimuli, only playback of killer whale calls. The sensitive responses of the Arctic species may relate to the fact that these animals are hunted using motorized boats. Other factors specific to the Arctic that may contribute to this sensitivity are sounds of ice-breaking that may mimic a potentially dangerous movement of ice, scarcity of ships in the high Arctic, and low background noise and good underwater sound propagation in Arctic waters.
- Controlled playback experiments and observations around actual industrial sources show bowhead whales avoid drill ship noise at estimated RLs of 110 to 115 dB re 1 µPa (rms) (SPL) and seismic sources at estimated RLs of 110 to 132 dB re 1 µPa (rms) (SPL) (Richardson et al., 1995a; Richardson, 1997, 1998).

C-2.6.2 SELECTION OF SPECIES AND STUDY SITES

The selection of species and study sites for the LFS SRP emerged from an extensive review in several workshops by a broad group of interested parties: academic scientists, federal regulators, and representatives of environmental and animal welfare groups. The outcome of this group's decisions was that baleen whales became the focus of all three projects, since they were thought most likely among all marine species to have sensitive hearing in the SURTASS LFA sonar frequency band, because of their protected status and because of prior evidence of avoidance responses to LF sounds. Study sites were selected that offered the best opportunities for detailed observations combined with previous research that documented undisturbed patterns of behavior and distribution, or avoidance reactions to anthropogenic sound at low RLs.

This focus on the most sensitive species and the best sites for detecting a response was intended to produce a model of response that could be applied to other species for which data were lacking. This was a critical element of the logic of the LFS SRP. Extrapolation was unavoidable. By selecting marine mammal species that probably have the most sensitive LF hearing, the LFS SRP results produced a model of response that is likely to overestimate the responses of other species.

The species and settings chosen for the three phases of the LF sound playback experiments were:

Blue and fin whales feeding in the Southern California Bight (Phase I) (September-October 1997);
Gray whales migrating past the central California coast (Phase II) (January 1998); and
Humpback whales off Hawaii (February-March 1998) (Phase III).

These studies included three important behavioral contexts for baleen whales: feeding, migrating, and breeding. The first phase also involved some studies of northern elephant seals tagged with acoustic data loggers. Elephant seals are considered among the most sensitive pinnipeds to LF sound and are deep divers (Le Boeuf, 1994). The third phase was designed to include playbacks with sperm whales, but no animals were encountered during the offshore portions of the cruise schedule. Sperm whales are listed by the U.S. as endangered under the ESA, and they were suspected to be the toothed whale most sensitive to LF sound (Ketten, 1997). There have also been reports of sperm whales being sensitive to anthropogenic transient noise (Watkins and Schevill, 1975; Watkins et al., 1985; Bowles et al., 1994; Mate et al., 1994b). (Based on the most recent scientific data, it is believed that the hearing of sperm whales is most sensitive at frequencies between 5 and 20 kHz [see Chapter 3 of this document for more details].)

C-2.6.3 RESEARCH PROGRAM

The 1997-98 LFS SRP was designed to ensure that no marine mammal was exposed to RLs exceeding 160 dB re 1 μPa (rms) (SPL). The LFS SRP produced new information about responses to the SURTASS LFA sonar sounds at RLs from 120 to 155 dB re 1 μPa (rms) (SPL). The LFS SRP team explicitly focused on situations that promoted high RLs (maximum 160 dB re 1 μPa [rms] [SPL]), but were seldom able to achieve RLs in the high region of this exposure range due to the natural movements of the whales and maneuvering constraints of the LF source vessel.

During the first phase of LFS SRP research, the source ship operated routinely with the full source array (18 source projectors) at source levels similar to those that would be used in normal Navy operations (Clark et al., 2001). The ship also approached whales while operating two of the projectors at full power levels. Over the 19-day period, there were no immediately obvious responses from either blue or fin whales as noted during observations made from any of the research vessels during playback of LFA sounds (Croll et al., 2001b).

In the second phase of LFS SRP research, migrating gray whales showed responses similar to those observed in earlier research (Malme et al., 1983, 1984) when the source was moored in the migration corridor (2 km [1.1 nmi] from shore). The study extended those results with confirmation that a louder SL elicited a larger scale avoidance response. However, when the source was placed offshore (4 km [2.2 nmi] from shore) of the migration corridor, the avoidance response was not evident. This implies that the inshore avoidance model—in which 50% of the whales avoid exposure to levels of 141 ±3 dB re 1 μPa (rms) (SPL)—may not be valid for whales in proximity to an offshore source (Buck and Tyack, 2000).

The third phase of LFS SRP research examined potential effects of SURTASS LFA sonar transmissions on singing humpback whales. These whales showed some apparent avoidance responses and cessation of song during specific LFA sound transmissions at RLs ranging from 120 to 150 dB re 1 μPa (rms) (SPL). However, an equal number of singing whales exposed to the same levels showed no cessation of song during the same LFA sound transmissions. Of the whales that did stop singing, there was little response to subsequent LFA sound transmissions; most joined with other whales or resumed singing within less then an hour of the possible response. Those that did not stop singing, sang longer songs during the period of LFA transmissions, and returned to baseline after transmissions stopped (Miller et al., 2000; Clark et al., 2001; Fristrup et al., 2003). Further analysis is required to establish how often male humpbacks stop singing in the absence of the SURTASS LFA sonar transmissions, and to evaluate the significance of the song cessation observed during playbacks.

This kind of brief interruption, followed by resumption of normal interactions, was similar to that seen when whales interrupt one another or when small vessels approach whales (Miller et al., 2000). If whales are in a breeding habitat where vessel interactions are frequent, then the aggregate impact of all disruptive stimuli could become significant. However, because the SURTASS LFA sonar system would be operated well offshore of these humpback breeding areas, it is likely that the cumulative impact of numerous inshore vessels would be significantly greater on these animals than that caused by an occasional offshore series of SURTASS LFA sonar transmissions.

In summary, the scientific objective of the LFS SRP was to conduct independent field research in the form of controlled experimental tests of how baleen whales responded to SURTASS LFA sonar signals. Taken together, the three phases of the LFS SRP do not support the hypothesis that most baleen whales exposed to RLs near 140 dB re 1 μPa (rms) (SPL) would exhibit disturbance of behavior and avoid the area. These experiments, which exposed baleen whales to RLs ranging from 120 to about 155 dB re 1 μPa (rms) (SPL), detected only minor, short-term behavioral responses. Short-term behavioral responses do not necessarily constitute significant changes in biologically important behaviors. The fact that none of the LFS SRP observations revealed a significant change in a biologically important behavior helped determine an upper bound for risk. The LFS SRP results cannot, however, be used to prove that there is zero risk at these levels. Accordingly, the risk continuum presented below assumes that risk is small, but not zero, at the RLs achieved during the LFS SRP. The risk continuum modeled a smooth increase in risk that culminates in a 95 percent level of risk of significant change in a biologically important behavior at 180 dB SPE. In this region, the risk continuum is unsupported by observations. However, the AIM simulation results indicate that a small fraction of any marine mammal stock would be exposed to sound levels exceeding 155 dB re 1 μPa (rms) (SPL).

C-2.7 RISK CONTINUUM ANALYSIS

The values of <u>B</u>, <u>A</u>, and <u>K</u> need to be specified in order to utilize the risk function in Subsection C-2.5.2. The risk continuum function approximates the dose-response function in a manner analogous to pharmacological risk assessment. In this case, the risk function is combined with the distribution of sound exposure levels to estimate aggregate impact on a stock.

C-2.7.1 BASEMENT VALUE FOR RISK—THE <u>B</u> PARAMETER

The <u>B</u> parameter defines the basement value for risk, below which the risk is so low that calculations are impractical. This 119-dB SPE level is taken as the estimate of RL (SPE) below which the risk of significant change in a biologically important behavior approaches zero for the SURTASS LFA sonar risk assessment. This level is the value at which avoidance reactions have been noted in bowhead, beluga and gray whales (which are mitigated by geographic restrictions on SURTASS LFA sonar operations [see Subsection C-2.6.1]). The Navy recognizes that for actual risk of changes in behavior to be zero, the signal-to-noise ratio at the animal must also be zero. However, the present convention of ending the risk calculation at 119 dB SPE has a negligible impact on subsequent calculations, because the risk function does not attain appreciable values until RLs (SPEs) exceed 130 dB SPE (Figure C-13b).

C-2.7.2 RISK TRANSITION—THE <u>A</u> PARAMETER

The <u>A</u> parameter controls how rapidly risk transitions from low to high values with increasing RL (SPE). As <u>A</u> increases, the slope of the risk function increases. For very large values of <u>A</u>, the risk function can approximate a threshold response. The value used here (<u>A</u>=10) (Figure C-13b) produces a curve that has a more gradual transition than the curves developed by the analyses of migratory gray whale studies (Malme et al., 1984). The choice of a more gradual slope than the empirical data was consistent with all other decisions to make conservative assumptions when extrapolating from other data sets.

C-2.7.3 THE <u>K</u> PARAMETER

Given the lack of consistent and sustained response in all three LFS SRP phases, the RL (SPE) at which 50% risk may occur is above 150 dB SPE. Thus, the LFS SRP data cannot be used to specify the value of <u>K</u> directly. Instead, this analysis set the value of <u>K</u> (in conjunction with <u>A</u>) such that the risk for an SPE exposure of 150 dB SPE was 2.5% and the risk at 180 dB SPE was 95%. Thus, <u>K</u> equals 46 dB, which is the RL (SPE) increment above basement at which there is 50 percent risk, leading to an estimated 50 percent risk at an SPE of 165 dB (i.e., 119 dB + 46 dB). The 2.5% risk estimate at 150 dB SPE reflects the fact that tens of experimental trials at RLs (SPEs) up to 155 dB failed to reveal any response that could be construed as affecting survival or reproduction. The 95% risk value at 180 dB SPE reflects the assumption that most individuals may be at risk but that a small fraction (5%) of the population would not be at risk.

C-2.7.4 BIOLOGICAL CONTEXT

<u>Reiteration of Biological Context in Analysis Process from the FOEIS/EIS (DoN, 2001)</u>

This Subsection was originally Subchapter 4.2.7.5 of the FOEIS/EIS and it is included below to completely address the thinking surrounding the implementation of the Risk Continuum at the time of the FOEIS/EIS, and as a basis for the current implementation. It is important to remember that all of the LFS SRP results were based on a 60-sec LFA transmission. Thus, by addressing each transmission's RL by its SPL level in dB re 1 µPa (rms), it is and was understood that an equivalent SEL value for that signal would be 17.7 dB higher (i.e., 10 × Log(60 seconds) = 17.7 dB). Similarly, the SPE values would 17.7 dB higher if the energy for the signal duration was included in that value. Additionally, since most, if not all, of the scientific data at the time were measured or estimated using SPL values, an SPL-based view was used in this discussion. It must be emphasized that all three of the LFS SRPs and the 2001 analysis recognized and included the duration of the LFA signal (and the contribution of multiple signals) as a critical and significant part of the estimation of potential impacts on marine mammals. Essentially, this approach was conservatively estimating (and including) the potential effects of both SPL and SEL, both for Level A and Level B impacts, long before the science was able to show the need to do so. Finally, the conservativeness built into these calculations remains valid even after ten or more years of focused scientific investigations.

The LFS SRP field research provided important results on and insights into the types of responses of whales to SURTASS LFA sonar signals and how those responses scaled relative to RL and context. Prior to the LFS SRP, marine mammal scientists expected immediately obvious responses from whales at exposure levels > 140 dB re 1 µPa (rms) (SPL) and statistically significant responses at RLs around 120 dB re 1 µPa (rms) (SPL). This expectation was based on responses detected in previous research to continuous industrial sounds (Malme et al. 1983, 1984; Richardson et al. 1995b).

The LFS SRP results showed that some whales responded to SURTASS LFA sonar signals: some whales either changed their levels of vocal activity, moved away from or approached the SURTASS LFA source vessel, or did both. In Phase II, there was a statistically significant avoidance response when the source was inshore (but not offshore) (Buck and Tyack, 2000). The level of response was in proportion to the level of sound received at the whale. In Phase III, some whales reduced vocal activity or avoided the SURTASS LFA sonar vessel. Those that continued singing, increased song length, but the tendency for these responses did not increase with increasing RL (Tyack and Clark 1998; Miller et al., 2000). However, in all cases, responding whales resumed normal activities within a few tens of minutes after initial exposure to the LFA signal.

Thus, overall, the LFS SRP results confirmed that some portion of the whales exposed to the SURTASS LFA sonar responded behaviorally, but the responses were short-lived.

It is important to raise the question of what level of behavioral response could result in a stock-level impact and, therefore, threaten a species' survival. Calculations carried out in this appendix provide the basis for the conclusion that the potential impact on any stock of marine mammals from injury due to SURTASS LFA sonar operations is negligible. The primary potential effect from SURTASS LFA sonar is significant change in a biologically important behavior. For this to translate into a stock-level impact, a significant portion of a population would have to be exposed to and respond to SURTASS LFA sonar so as to effectively reduce the chances of individual survival or breeding. The most likely scenario that marine biologists could hypothesize under which this might happen was if SURTASS LFA sonar was operated in a concentrated breeding area throughout an entire breeding season, or operated in a feeding area for months at a time. The Navy's plans for SURTASS LFA sonar operation significantly reduce the chances of such scenarios, because: 1) the SURTASS LFA sonar will not be operated within 22 km (12 nmi) of the coastline, or in places and during times of the year when marine mammals are engaged in critical activities, and 2) because of short (maximum 20-day) mission lengths (The FSEIS in 2007 and this SEIS/SOEIS now identify 7-20 days as the typical length of a mission.)

Another possible concern would be that a large percentage of a marine mammal stock could be exposed to moderate to low received sound levels over the long term. If animals are affected at these moderate to low exposure levels such that they experience significant changes in biologically important behaviors after long-term exposure, then such exposures could have an impact on rates of reproduction or survival. Analysis results discussed below address this concern.

The AIM estimations (incorporating LFS SRP results) help quantify the exposure statistics at the stock level. In order to understand the significance of the normalized percentages of a stock estimated at risk (i.e., the typical value used to present LFA potential impacts on a stock), it is necessary to consider how this risk might affect an animal's life history (including the potential for long-term impacts). For example, and purely as a hypothetical case, in an open ocean breeding area, some fraction of the animals might have a reduced probability of breeding during the 7 to 20 days of transmissions (maximum time for a typical at-sea mission in an operational area). Using a very conservative assumption that half of the animals lost one quarter of their breeding season, this would represent a loss of from 1 to 5% of an animal's lifetime reproduction potential (1% of total lifetime breeding periods for larger, long-lived animals; 5% for smaller, short-lived animals).

For example, one-half of 1,000 animals in an open ocean breeding area = 500 animals; assume 20 breeding seasons in a lifetime, so loss of one quarter of one season = 1 ÷ (20 x 4) = 0.0125, or approximately 1% of an animal's lifetime potential. Thus, in this example, 500 of the animals in this breeding area would lose 1% of their lifetime breeding potential. The larger fraction of 5% would be associated with some of the smaller marine mammals; however, the potential severity of this effect is mitigated at the stock level by their larger stock sizes and shorter generation times.

Thus, the percentage of the stock affected biologically would be a very small fraction of the overall stock. These types of assessments that include a potential for long-term impact at the individual level have been the basis for the estimate of very small, if not negligible, potential for impacts at the stock level, and emphasize the conservativeness of the AIM risk estimates.

The impact on foraging animals might be comparable to that in breeding areas. Here, it is assumed that the impact would involve reduced foraging efficiency for at most 20 days out of a foraging season of perhaps 90 days. Even with a 25% reduction in foraging efficiency for all of the 20 days, this would represent only a 5% reduction in food intake for that season. For example, 25% of 20 days = 5 days; 5 days out of 90 days = 5.5% (5 ÷ 90 = 0.055). In both cases, 20 days of exposure is certainly an overestimate of the duration, because most of the SPE exposure for individuals with high risk values takes place during a small fraction of the SURTASS LFA sonar exercise, when the individuals happen to pass close to the ship.

The preceding discussion assumes that animals at risk do not move away from the SURTASS LFA sonar source to lessen its effects. Richardson et al. (1995b) stated that it would be unlikely that any marine mammal would remain for long in areas where there was continuous underwater noise exceeding RL 140 dB re 1 μPa (rms) (SPL). However, no reduction in sighting rates (see LFA Technical Report #1 for the FOEIS/EIS Tables B-1, 2 and 3 [LFS SRP Phase I], and Tables D-1, 2 and 3 [Phase III]) or acoustic detection was found within the vicinity of the SURTASS LFA sonar source vessel during LFS SRP projects (lasting for a few weeks). Thus, avoidance of the >140 dB re 1 μPa (rms) (SPL) zone of exposure occurred much less than expected.

C-2.8 SAMPLE MODEL RUN

The following two examples were presented in the FOEIS/EIS (DoN, 2001). They were intended to illustrate the PE model and AIM simulation and the subsequent analysis of the resulting data using the risk continuum. The steps of the risk analysis, including the inputs and outputs of each process, are illustrated in Figure C-14. Each of these elements will be described in the following examples. These selected sites are representative of the type of detail and methodology of the analysis used for LFA impact analyses, and they were those actually used in the FOEIS/EIS (DoN, 2001).

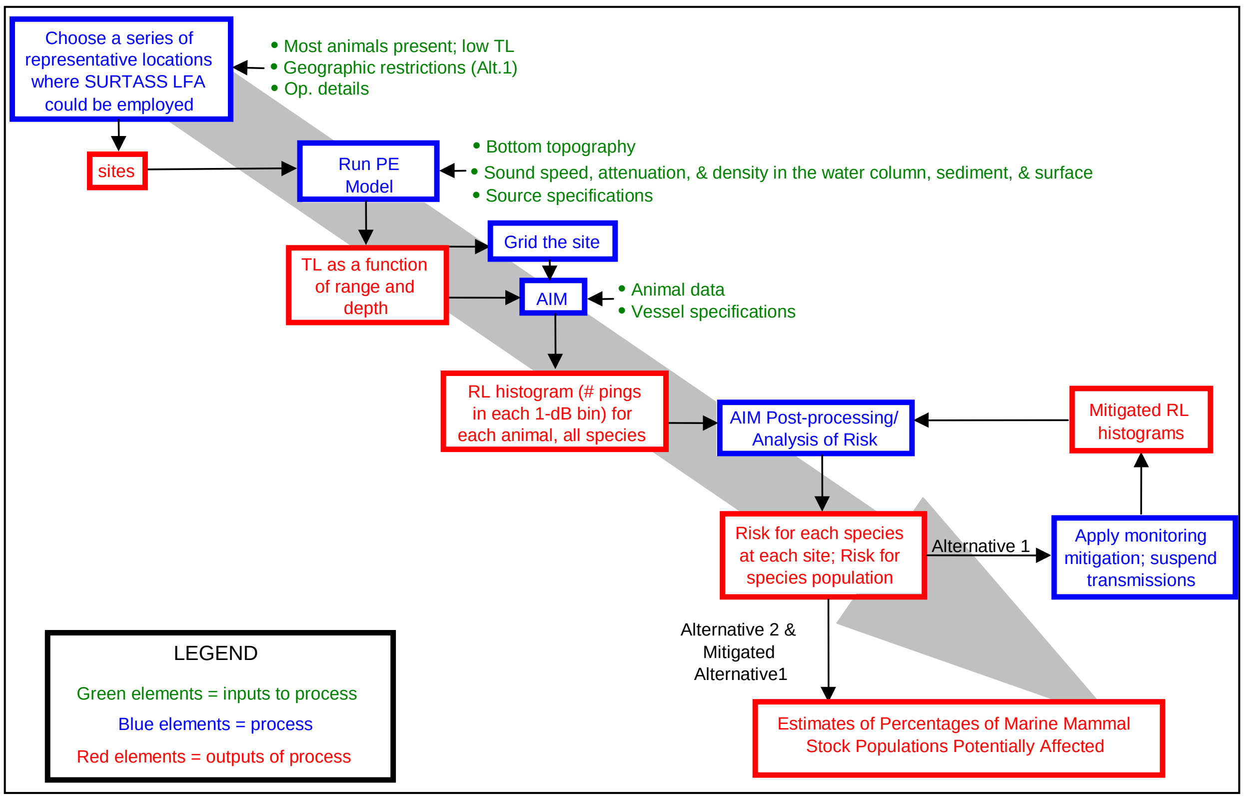


Figure C-14. Flowchart of SURTASS LFA sonar risk analysis.

C-2.8.1 PE MODEL INPUT PARAMETERS AND DATA

Table C-12 provides many of the acoustic and positional parameters required for the acoustic modeling in these two examples. The Navy standard PE acoustic model, with the accompanying data bases, was used to model the environment and examine four azimuths. Two sample PE field plots showing the 000º true bearing are provided as Figure C-15 and Figure C-16. These figures show the TL predicted for each site as a function of range from the source and depth in the ocean. In each figure, the source is in the upper far left of the plot (i.e., where the small arrow points to the depth axis at 120 m [400 ft]) where the TL values are lowest. For the Gulf of Alaska case note the presence of the duct as indicated by the low level of TL (approximately 80 to 85 dB and colored yellow) at the 120 to 150-m (400 to 500-ft) depth out to over 185 km (100 nm) from the source. In the Onslow Bay case, the propagation mode is strongly bottom interactive (bottom bounce) due to the water depth and sound speed profile, with the energy in the water column decreasing rapidly as it propagates up-slope and toward shore.

The locations of these examples can be seen in Figure C-17 and Figure C-18 as the dots. Also shown on these figures is the sectioning, or grid spacing, used to create the initial distribution of the marine animals. In the first case (Gulf of Alaska), the source is well offshore (approximately 330 km [180 nmi]) and in

Table C-12. PE input parameters.

PARAMETER	*GULF OF ALASKA*	ONSLOW BAY
Location	57°N, 147°W	33°5' N, 76°15' W
Season	Summer	Spring
Source Depth	400 ft (120 m)	400 ft (120 m)
Source Beam Pattern	Omni-directional source	Omni-directional source
Frequency	300 Hz (nominal)	300 Hz (nominal)
Repetition Rate	Every 15 min	Every 15 min
Azimuthal Radials Modeled	000, 090, 180, 270°True (T)	000, 090, 180, 270°T

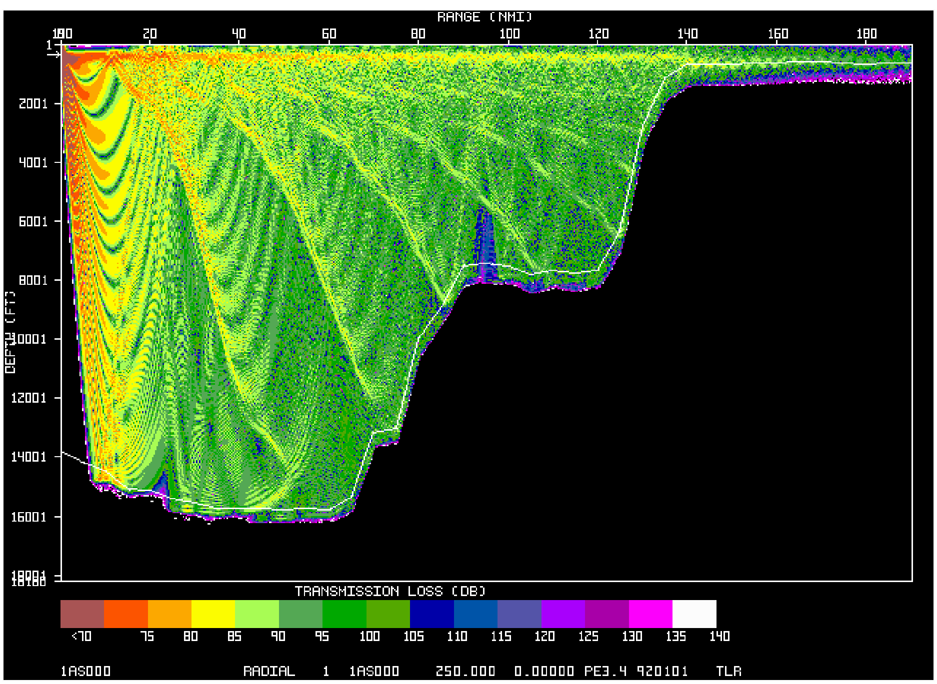


Figure C-15. PE field plot for the Gulf of Alaska, 000°T azimuth.

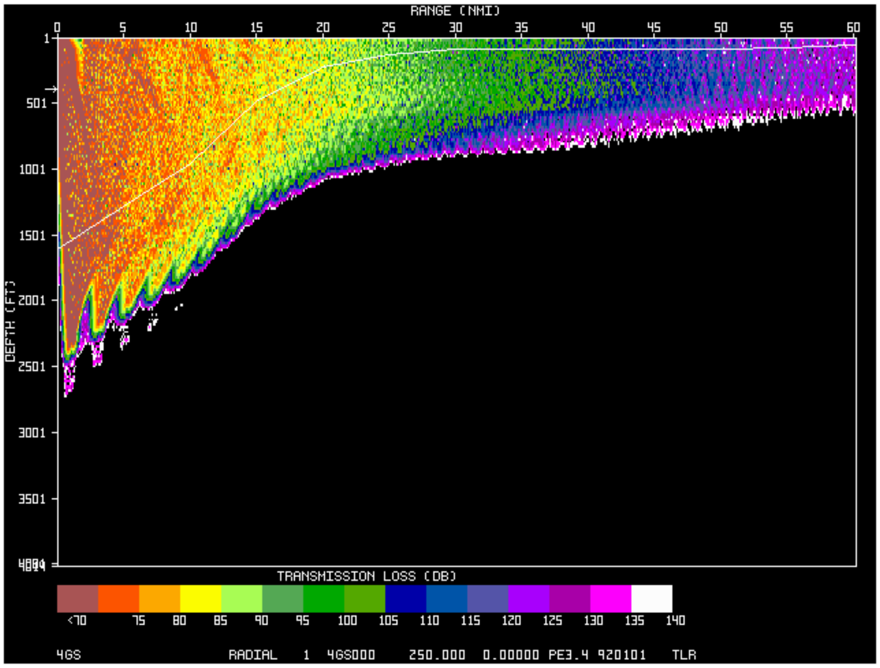


Figure C-16. PE field plot for Onslow Bay, 000°T Azimuth.

1

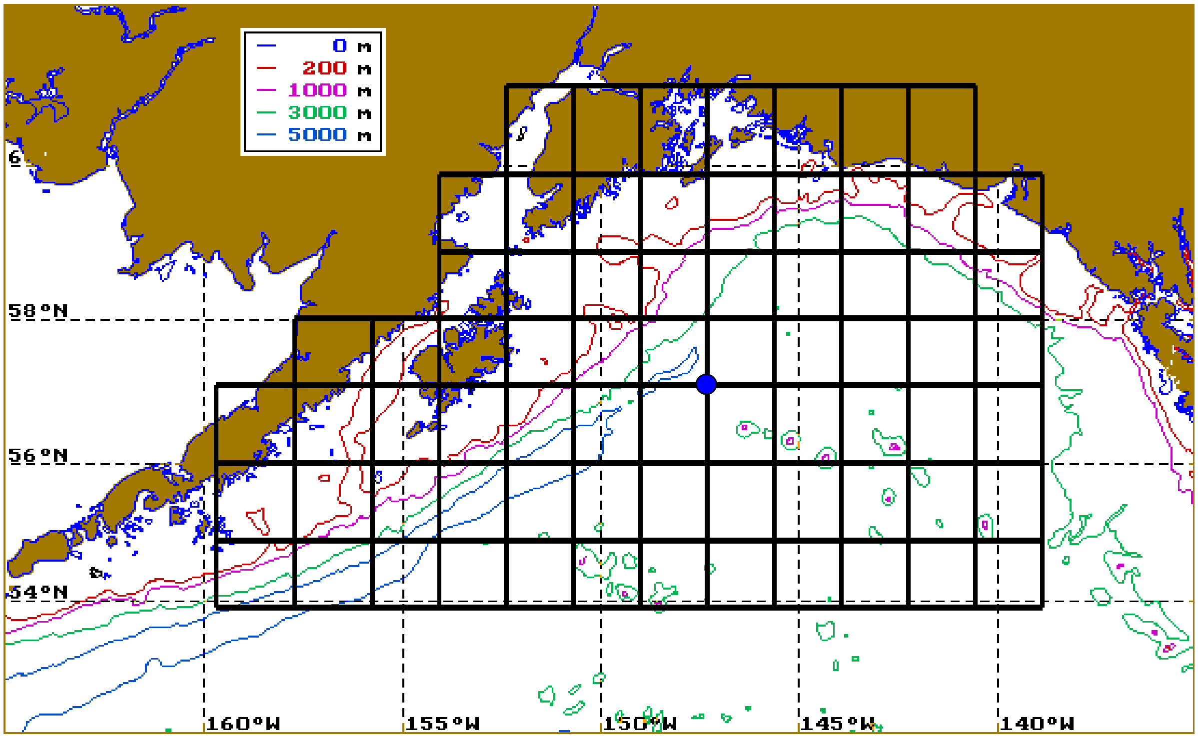


Figure C-17. AIM Site 1, northern Gulf of Alaska.

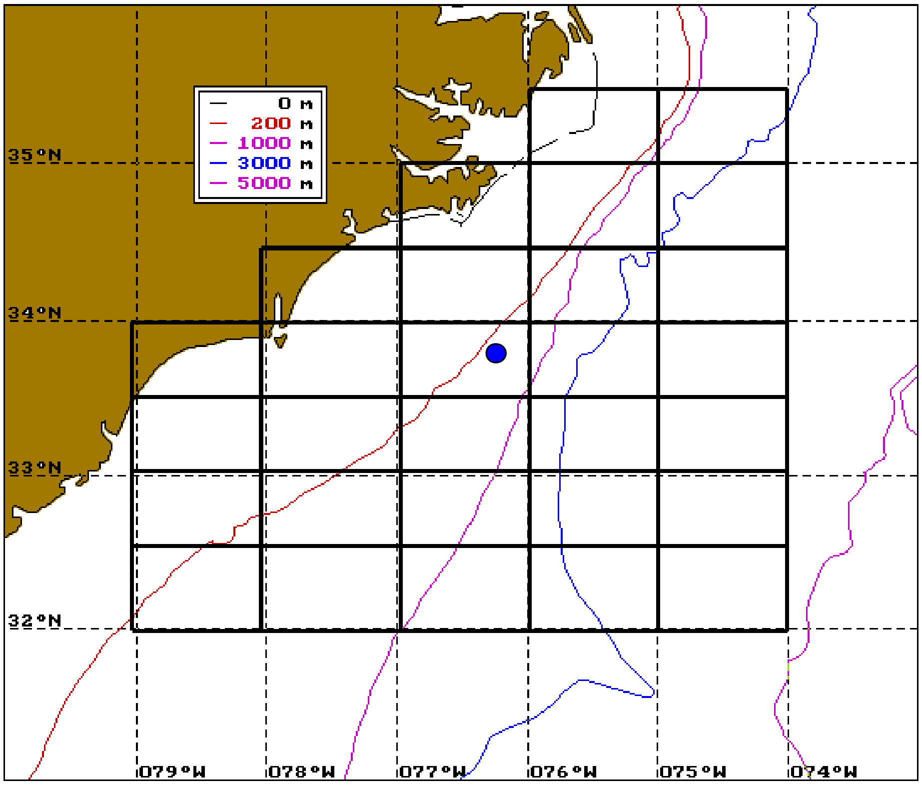


Figure C-18. AIM Site 28, Onslow Bay.

relatively deep water, while for the Onslow Bay case the source is in water less than 305 m (1,000 ft) deep, and closer (111 km [60 nmi]) to shore.

C-2.8.3 AIM INPUT PARAMETERS AND DATA

The initial distribution of marine animals is provided to AIM by a Monte Carlo method (see box). In this method, each of the sections (i.e., the rectangles shown in Figures C-17 and C-18) is assigned an animal weight or density for each of the modeled species, and the Monte Carlo method distributes the start positions of the animals in the sections. The distributions of the initial positions for two of these species, blue and humpback whales, are provided in Figure C-19 and Figure C-20, respectively for the Gulf of Alaska case.

Monte Carlo Method

The Monte Carlo Method is a technique for obtaining an approximate solution to certain mathematical and physical problems, characteristically involving the replacement of a probability distribution by sample values and usually done on a computer (Neufeldt, 1997).

Figure C-21 and Figure C-22 show the initial positions of northern right whales and beaked whales in the Onslow Bay site. Note that in the Gulf of Alaska, the humpbacks are concentrated primarily near shore, while the blue whales remain offshore (i.e., greater than 110 km [60 nmi] offshore). In the Onslow Bay

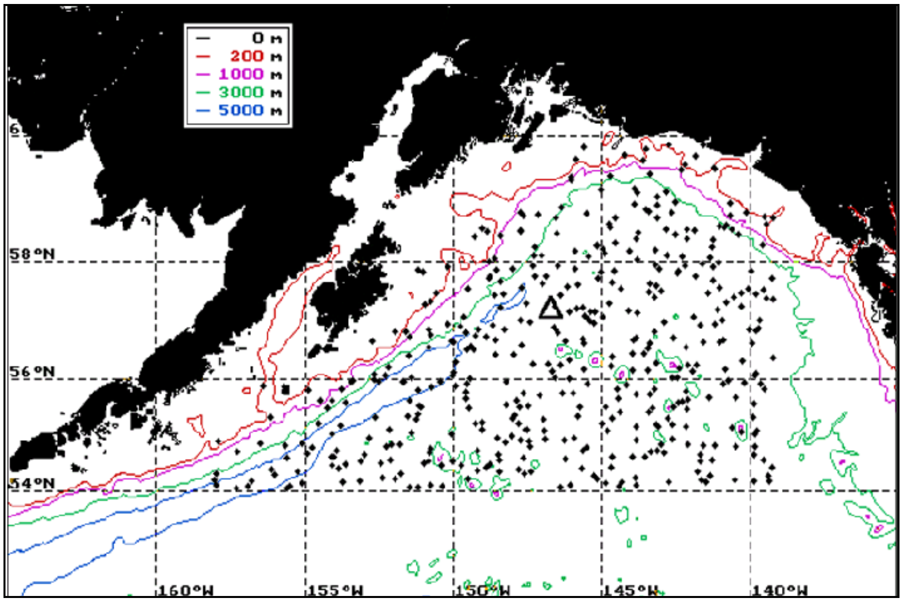


Figure C-19. Initial blue whale positions, Gulf of Alaska.

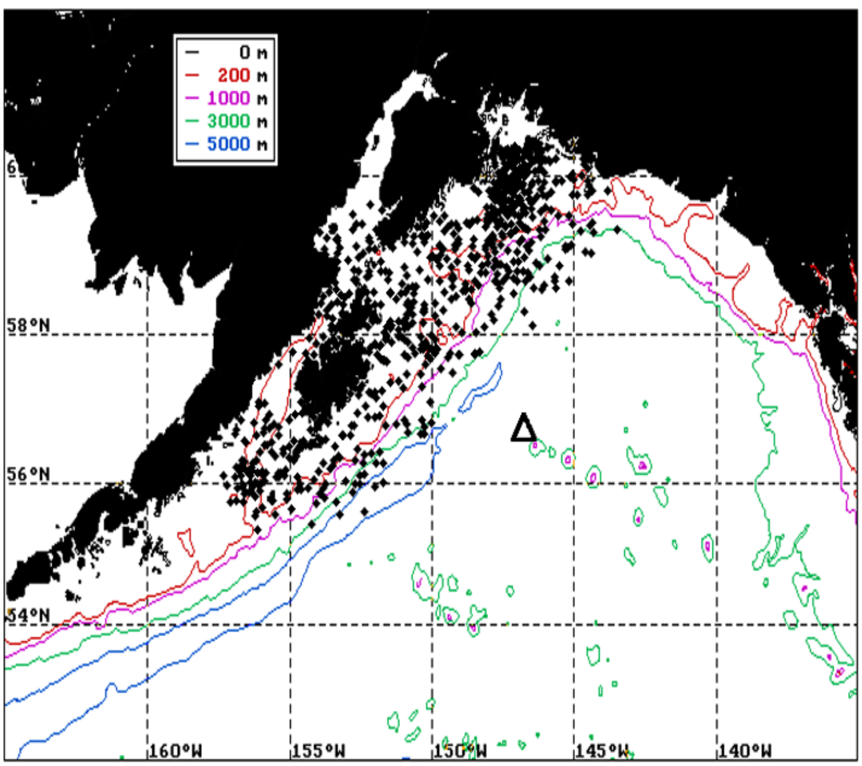


Figure C-20. Initial humpback whale positions, Gulf of Alaska.

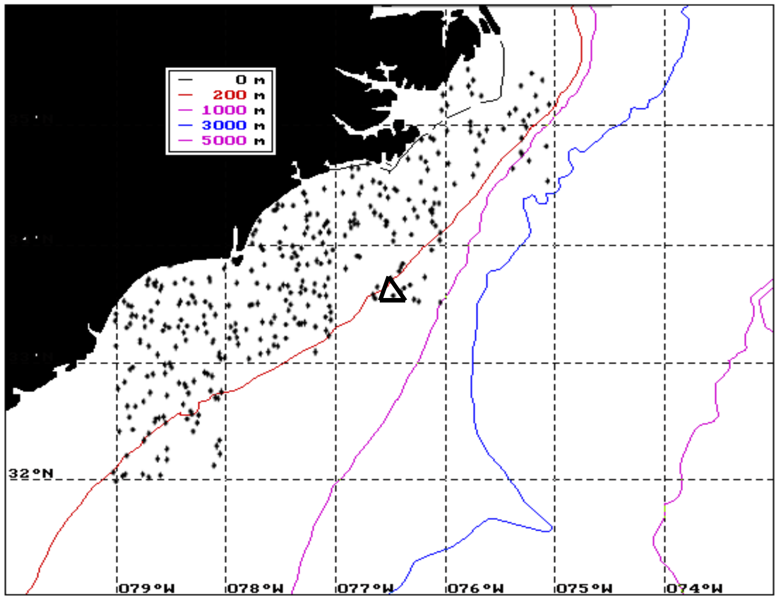


Figure C-21. Initial northern right whale positions, Onslow Bay.

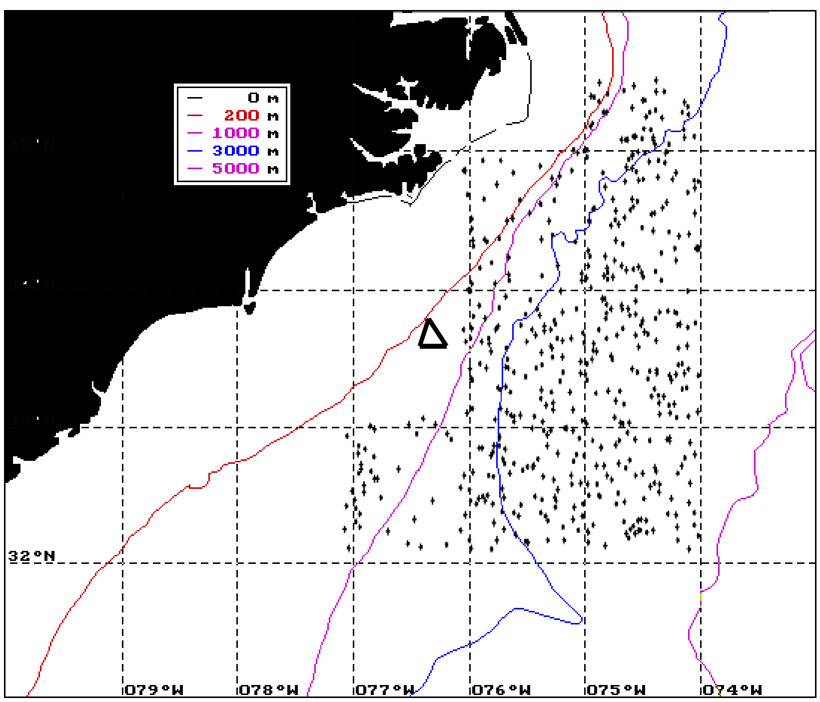


Figure C-22. Initial beaked whale positions, Onslow Bay.

site, the northern right whales are also concentrated near shore, while the beaked whales remain farther offshore, distributed in deeper water. Each of these figures also shows the ship track (triangle) for a typical 24-hour period.

It should be noted that the best available scientific data for each species were used to model their individual dive profiles (animal dive data were used when available; otherwise surrogate animal data were used) and distributions in the modeled areas. This precluded homogeneously-distributed animal densities in the three dimensions of latitude, longitude, and depth, as can be seen in the initial animal positions shown in Figures C-19, C-20, C-21, and C-22. Furthermore, the percentage of the stock that is included in the modeled area compared to the entire stock region is unique to each species. For example, 43.6% of the eastern North Pacific humpback stock is expected in the Gulf of Alaska case, whereas only 4.4% of the eastern North Pacific pelagic dolphin stock is expected in the Gulf of Alaska site. Obviously, these factors (dive profile, local distribution pattern, and regional stock distribution pattern) will influence the percentage of the stock potentially affected, and the resulting take estimates.

Table C-13 identifies most of the other critical parameters used with AIM. The animal decision interval, which in this analysis coincided with the transmission cycle, allowed animals to maneuver in three dimensions. The animal cone direction specified in the table was the variation in direction that the animal was allowed to take at any one of these decision points. In these cases, the animals could maneuver in azimuth in an unrestricted manner. Table C-14 identifies the four diving zones for the blue, humpback, northern right and beaked whales used in this example and the percentage of time the animals are assumed to spend at each depth.

Table C-13. AIM input parameters.

PARAMETER	VALUE
Source Vessel Speed	3 knots (1.5 m/sec)
Source Vessel Courses	150, 270, 030°T
Source Leg Duration	8 hours (3 legs per day)
Mission Duration	20 days (repeat triangle 20 times)
Animal Speed	3 knots (1.5 m/sec)
Animal Decision Interval	15 min
Animal Directional Cone	360°

In these regions, for these two modes of propagation (ducted and bottom interactive), it was determined that at least 100 and 200 animals (for the 20-day period with a 15-minute transmission repetition rate) were required to achieve statistical significance for the Gulf of Alaska and Onslow Bay cases, respectively. In these cases, 460 blue and humpback whales were modeled for the Gulf of Alaska, while 520 northern right whales and 380 beaked whales were modeled for Onslow Bay, based on density estimates.

As stated earlier, the number of animals modeled does not represent the actual estimated abundance in the area. Once the model is run and a statistically significant result is obtained, this result is scaled (i.e., multiplied or divided by a scaling factor) until it is appropriate for the actual estimated animal abundance

Table C-14. Diving regimes.

Zones	*Blue and Humpback*		Northern Right		Beaked	
	Depth Range (ft/m)	Percent of Time in Regime	Depth Range (ft/m)	Percent of Time in Regime	Depth Range (ft/m)	Percent of Time in Regime
Surface	0-50/ 0-15.2	12	0-50/ 0-15.2	80	0-50/ 0-15.2	17
Transition	50-270/ 15.2-82	40	50-150/ 15.2-45.7	5	50-1200/ 15.2-365.8	13
Average Diving	270-522/ 82-159	43			1200-1800/ 365.8-548.6	50
Maximum Diving	522-612/ 159-186.5	5	150-250/ 45.7-76.2	15	1800-3500/ 548.6-1066.8	20

in the modeled site area. For example, if 460 whales were modeled and the abundance estimate was actually 920 whales, the results would be scaled up (multiplied) by a factor of 2 (i.e., 920 ÷ 460 = 2).

C-2.8.4 Processing AIM Results Using the Risk Continuum

The AIM results were then processed using the risk continuum to derive the percentages given in Tables C-15 and C-16. These percentages estimate the portion of the stock potentially affected due to SPE levels ≥180 dB, and potentially affected due to all SPE levels, for Alternative 1 (geographic mitigation only, and geographic plus monitoring mitigation). These values were corrected to account for the percentage of animals affected in relation to the area's stock. The mathematics of processing the AIM results using the risk continuum consists of the following steps:

- AIM output data, histograms of number of transmissions in each RL bin, were translated into an SPE RL for each individual in a modeled stock;
- SPE RLs were translated into risk probabilities using the single-ping risk function;
- The risk probabilities for all individuals were summed to obtain an aggregate risk value expressed as the percentage of the modeled stock potentially affected; and
- The risk probability for the modeled stock was multiplied by the ratio of the actual stock to the modeled stock to obtain a normalized risk value for the regional stock.

For example, suppose SPE risks for a modeled stock of five animals from an actual stock of 100 animals are calculated as 2.5, 1.1, 5.3, 3.4, and 1.7%. The risk to the modeled stock is the average of the five individual risks (2.8%). The risk to the actual stock would then be 0.14% (i.e., 2.8 x 5/100). This value is used as the percentage of stock potentially affected.

Table C-15. Potentially affected stock (geographic mitigation only).

SITE	SPECIES	POTENTIAL FOR EFFECTS ≥180 DB re 1 µPa (rms) RL (%)	POTENTIAL FOR EFFECTS—ALL RLS (%)
Gulf of Alaska	Blue whales	0	6.87
	Humpback whales	0	12.39
Onslow Bay	Northern right whales	0.31	1.19
	Beaked Whales	0	0.01

Table C-16. Potentially affected stock (geographic and monitoring mitigation).

SITE	SPECIES	POTENTIAL FOR EFFECTS ≥180 DB re 1 µPa (rms) RL (%)	POTENTIAL FOR EFFECTS—ALL RLS (%)
Gulf of Alaska	Blue whales	0	6.87
	Humpback whales	0	12.39
Onslow Bay	Northern right whales	0	0.88
	Beaked Whales	0	0.01

For example, suppose SPE risks for a modeled stock of five animals from an actual stock of 100 animals are calculated as 2.5, 1.1, 5.3, 3.4, and 1.7%. The risk to the modeled stock is the average of the five individual risks (2.8%). The risk to the actual stock would then be 0.14% (i.e., 2.8 x 5/100). This value is used as the percentage of stock potentially affected.

C-2.8.5 DISCUSSION OF THE VALIDITY OF THE SPE METHOD FOR LFA ENERGY SUMMATION

A recent paper by Finneran et al. (2010) stated that, "The SPE approach resulted in increasing underestimation of TTS_4 (TTS_4 refers to TTS measured 4 min after exposure to the fatiguing stimulus), with little accumulation of TTS as the number of exposures increased." At first glance this would tend to indicate that the entire SURTASS LFA sonar impact analysis, which relies on SPE as a core metric, underestimates potential impacts. And while the above quote is correct for the data it applies to, the extrapolation to the entire SURTASS LFA sonar analysis is inappropriate for the following reasons:

- The data collected by Finneran et al. (2010) were for TTS measurements of bottlenose dolphins at about 3 kHz, where TTS is induced by exposure (RL) to 1-sec tones of 192 dB re 1 µPa (rms) (SPL). As shown in the audiograms presented in Richardson et al. (1995b), bottlenose dolphins' most sensitive hearing is between 10 and 70 kHz. Their thresholds are about 10 to 20 dB higher at 3 kHz, whereas they are about 60 dB higher for frequencies below 1 kHz. Thus, for LFA frequencies (nominally 300 Hz), bottlenose dolphin hearing capability is greatly reduced. TTS at 300 Hz would be expected at a much higher RL than that identified in the Finneran et al. (2010) paper. Thus, even if the SPL (RL) that produced TTS at 3 kHz was increased by 20 dB, that SPL value (approximately

192 + 20 = 212 dB re 1 μPa [rms]) is approximately the strongest RL found anywhere in the LFA sound field, and then only within about 1 meter of any element.

- Extrapolating the Finneran et al. (2010) results to mysticetes, which are presumed to have much better hearing in the LFA frequency range, is not easy. Not only do these species likely have different hearing mechanisms, but there are no reliable measurements of their hearing thresholds, frequency ranges of greatest sensitivity, or SPLs that may induce TTS.
- The Finneran et al. (2010) experiment collected data on the growth of TTS during multiple exposures to an SPL (RL) of 192 dB re 1 μPa (rms). The bottlenose dolphin was presented with a sequence of four tones, each 16 sec in duration, with a 224-second quiet time between each successive tone, or with a single 64-sec tone. TTS was found to be greater for the single 64-sec signal than for the four 16-sec signals interspersed with some quiet time. That is, animals experienced TTS recovery. However, these results were obtained in an experimental setting. In order to experience the same exposure, the animal would need to remain in proximity to the SURTASS LFA transducer for the entire 60-sec duration of the signal. Thus, it is highly improbable that an animal would receive energy for an entire LFA signal, much less repeated exposures to multiple LFA transmissions, which would induce TTS. This conclusion is further strengthened by: a) the LFA source is also moving at 3 to 4 kts; b) SURTASS LFA sonar only transmits every 10 min or so, not the 224-sec (less than 4 min) interval tested by Finneran et al. (2010) (i.e., 10 min allows greater recovery time for the animal): and c) it is highly unlikely that an animal could approach and remain that close to the LFA source, which is at a nominal depth of 122 m (400 ft), without detection and remain there for the full duration of the signal.
- It should also be noted that the SPE metric was primarily designed to address the behavioral (i.e., non-injurious Level B) issue and not TTS, which now is included as temporary physiological harassment at the upper end of the range of Level B harassments. The reality is, for the analysis of the potential effects of LFA, most if not all, TTS harassments, if they occurred, are included in the estimate of potential Level A harassments, because they will typically have an SPE of greater than 180 dB SPE, the LFA threshold for Level A harassments. For example, for a dolphin with a TTS threshold of 195 dB re 1 μPa (rms) (SPL) for a 1 second signal at 3 kHz (conservative for the LFA frequency of 300 Hz), which received a 60 second LFA signal, the adjusted TTS threshold, accounting for the 60-sec duration of the signal (18 dB), is 177 dB re 1 μPa^2-sec (rms) (SEL or SPE) (since for this case there is only 1 signal)(i.e., 195-18 = 177 dB re 1 μPa^2-sec (rms) (SEL or SPE). With the accumulated energy from additional transmissions, this might sum to over 180 dB SPE. In a real-world LFA situation, considering the system’s transmission duration and ping intervals, with the vessel moving in two dimensions and the animal moving in three dimensions, and the source at a nominal depth of 122 m (400 ft), even if mitigation was not taken into account, it is highly unlikely that an animal would be exposed to multiple signals with accumulated energy summing to over 180 dB SPE.
- Finally, it should be noted that the methodology for calculating SPE in the SURTASS LFA FOEIS/EIS is very different from that identified in the Finneran et al. (2010) paper, where only one 64-sec or four 16-sec signals were received. Operationally for SURTASS LFA sonar, the system frequency, transmission duration and ping intervals are different from those used in the Finneran et al. (2010) analysis. Moreover, even if mitigation was not accounted for in the SURTASS LFA sonar analysis, it is highly unlikely that an animal would be exposed to more than one LFA signal that could induce TTS. The geometry of the movements of the source and animals preclude this. This is further borne out both by the LFA modeling and the difficulty of deliberately trying to expose animals to even 165 dB re 1 Pa (rms) (SPL) during the 1997-98 Low Frequency Sound Scientific Research Program (LFS SRP).

The Finneran et al. (2010) experiment appears to have been designed to address the issue of the suitability of the SURTASS LFA sonar SPE approach for analyzing the potential effects of mid-frequency active (MFA) sonar operations. Given the multiple acoustic and operational differences between MFA and LFA sonar noted above, this is inappropriate. Furthermore, regarding MFA sonar analysis, the statement in Finneran et al. (2010) that, “The SPE approach…resulted in increasing underestimates of TTS, with little accumulation of TTS_4 as the number of exposures increased.” is incompatible with SURTASS LFA sonar analyses using SPE, and does not reflect how SPE is currently used in modeling LFA scenarios.

C-3.0 SUMMARY

The sensitivity/risk process, discussed above, integrates mission planning needs (Navy’s training and operational ASW requirements) and a cautious assessment of the limited data available on specific marine mammal populations, and seasonal habitat and activity. In this supplemental analysis, 19 additional representative SURTASS LFA sonar operating sites have been analyzed using the most up-to-date marine mammal abundance, density, and behavioral information available. These sites were chosen because they represent, based on today’s political climate, areas where SURTASS LFA sonar could potentially test, train or operate. This analysis provides updated modeling for the 11 sites under the current LOAs and eight additional sites, which could be requested for LOAs under the next 5-year Rule because they are in areas of potential strategic importance and/or areas of possible Fleet exercises.

Estimates of the percentage of marine mammal stocks affected by SURTASS LFA sonar operations in the 19 potential operating areas, for the seasons specified, have been derived for this document (Tables C-17 through C-35). The estimated stock values support the conclusion that estimates of potential effects to marine mammal stocks are below the conditions delineated by NMFS in the LOAs issued under the current 2007 Final Rule.

Under the current 2007 Rule and LOAs, NMFS provided regulations and conditions to ensure that the incidental taking of marine mammals resulting from SURTASS LFA sonar operations would have the least practicable adverse impacts on the affected marine mammal species or stocks. During the periods of the current LOAs, the Navy has ensured that the authorized harassment levels are not exceeded by utilizing the above risk assessment procedures. The Navy also uses these regulations and conditions as guides in mission planning and annual LOA applications.

Table C-17. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 1, East of Japan, in summer.

OPAREA 1 (SUMMER): EAST OF JAPAN				
SPECIES	**DENSITY (/KM2)**	**# IN STOCK**	**STOCK**	**% STOCK AFFECTED <180 DB SPE**
Blue whale	0.0002	9,250	North Pacific	0.0182
Fin whale	0.0002	9.250	North Pacific	0.0221
Sei whale	0.0006	8.600	North Pacific	0.0661
Bryde's whale	0.0006	20,501	Western North Pacific	0.0277
Common minke whale	0.0022	25,049	"O" stock Western North Pacific	0.0566
North Pacific right whale (spring/fall)	0.00001	922	Western North Pacific	< 0.0001
Sperm whale	0.0010	102.112	North Pacific	0.0060
Kogia spp.	0.0031	350,553	North Pacific	0.0079
Baird's beaked whale	0.0029	8.000	Western North Pacific	0.2603
Cuvier's beaked whale	0.0054	90,725	North Pacific	0.0427
Gingko-toothed beaked whale	0.0005	22,799	North Pacific	0.0157
Hubbs' beaked whale	0.0005	22.799	North Pacific	0.0157
False killer whale	0.0036	16.668	Western North Pacific	0.1916
Pygmy killer whale	0.0021	30.214	Western North Pacific	0.0617
Short-finned pilot whale	0.0128	53.608	Western North Pacific	0.2170
Risso's dolphin	0.0097	83,289	Western North Pacific	0.1138
Common dolphin	0.0761	3,286,163	Western North Pacific	0.0212
Bottlenose dolphin	0.0171	168,791	Western North Pacific	0.0823
Spinner dolphin	0.0005	1,015,059	Western North Pacific	0.0002
Pantropical spotted dolphin	0.0259	438.064	Western North Pacific	0.0180
Striped dolphin	0.0111	570.038	Western North Pacific	0.0059
Rough-toothed dolphin	0.0059	145,729	Western North Pacific	0.0346
Fraser's dolphin	0.0040	220,789	Western North Pacific	0.0153
Pacific white-sided dolphin	0.0082	931,000	Western North Pacific	0.0070

Table C-18. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 2, North Philippine Sea, in fall.

OPAREA 2 (Fall): North Philippine Sea				
Species	**Density (/km2)**	**# in Stock**	**Stock**	**% Stock Affected <180 dB SPE**
Bryde's whale	0.0006	20,501	Western North Pacific	0.0339
Common minke whale	0.0044	25,049	"O" stock Western North Pacific	0.4023
North Pacific right whale (spring/fall/winter)	0.00001	922	Western North Pacific	0.0055
Sperm whale	0.0028	102,112	North Pacific	0.0454
Kogia spp.	0.0031	350,553	North Pacific	0.0265
Cuvier's beaked whale	0.0054	90,725	North Pacific	0.0534
Blainville's beaked whale	0.0005	8,032	North Pacific	0.0559
Gingko-toothed beaked whale	0.0005	22,799	North Pacific	0.0197
Killer whale	0.0004	12,256	North Pacific	0.0379
False killer whale	0.0029	16,668	Western North Pacific	0.2123
Pygmy killer whale	0.0021	30,214	Western North Pacific	0.0848
Melon-headed whale	0.0012	36,770	Western North Pacific	0.0398
Short-finned pilot whale	0.0153	53,608	Western North Pacific	0.5137
Risso's dolphin	0.0106	83,289	Western North Pacific	0.3337
Common dolphin	0.0562	3,286,163	Western North Pacific	0.0168
Bottlenose dolphin	0.0146	168,791	Western North Pacific	0.0548
Spinner dolphin	0.0005	1,015,059	Western North Pacific	0.0007
Pantropical spotted dolphin	0.0137	438,064	Western North Pacific	0.0429
Striped dolphin	0.0329	570,038	Western North Pacific	0.0792
Rough-toothed dolphin	0.0059	145,729	Western North Pacific	0.1109
Fraser's dolphin	0.0040	220,789	Western North Pacific	0.0411
Pacific white-sided dolphin	0.0119	931,000	Western North Pacific	0.0176

Table C-19. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 3, West Philippine Sea, in fall.

OPAREA 3 (Fall): West Philippine Sea				
Species	**Density (/km2)**	**# in Stock**	**Stock**	**% Stock Affected <180 dB SPE**
Fin whale	0.0002	9,250	North Pacific	0.0492
Bryde's whale	0.0006	20,501	Western North Pacific	0.0653
Common minke whale	0.0033	25,049	"O" stock Western North Pacific	0.1880
Humpback whale (winter only)	0.0000	1,107	Western North Pacific	< 0.0001
Sperm whale	0.0010	102,112	North Pacific	0.0105
Kogia spp.	0.0017	350,553	North Pacific	0.0099
Cuvier's beaked whale	0.0003	90,725	North Pacific	0.0042
Blainville's beaked	0.0005	8,032	North Pacific	0.0797
Gingko-toothed beaked whale	0.0005	22,799	North Pacific	0.0281
False killer whale	0.0029	16,668	Western North Pacific	0.2610
Pygmy killer whale	0.0021	30,214	Western North Pacific	0.1043
Melon-headed whale	0.0012	36,770	Western North Pacific	0.0490
Short-finned pilot whale	0.0076	53,608	Western North Pacific	0.1348
Risso's dolphin	0.0106	83,289	Western North Pacific	0.2284
Common dolphin	0.0562	3,286,163	Western North Pacific	0.0325
Bottlenose dolphin	0.0146	168,791	Western North Pacific	0.0927
Spinner dolphin	0.0005	1,015,059	Western North Pacific	0.0004
Pantropical spotted dolphin	0.0137	438,064	Western North Pacific	0.0230
Striped dolphin	0.0164	570,038	Western North Pacific	0.0212
Rough-toothed dolphin	0.0059	145,729	Western North Pacific	0.0769
Fraser's dolphin	0.0040	220,789	Western North Pacific	0.0284
Pacific white-sided dolphin	0.0245	931,000	Western North Pacific	0.0211

Table C-20. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 4, Offshore Guam, in summer and fall.

OPAREA 4 (SUMMER AND FALL): OFFSHORE GUAM					
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE —SUMMER	% STOCK AFFECTED <180 DB SPE —FALL
Blue whale	0.0001	2,842	Eastern North	0.0377	0.0338
Fin whale	0.0003	9,250	Eastern North	0.0376	0.0354
Sei whale	0.00029	8,600	North Pacific	0.0331	0.0330
Bryde's whale	0.00041	20,501	Western North Pacific	0.0183	0.0197
Common minke whale	0.0003	25,049	"O" stock Western	0.0110	0.0104
Humpback whale (Oct-May)	0.0000	10,103	central North Pacific	<0.0001	< 0.0001
Sperm whale	0.0012	102,112	North Pacific	0.0105	0.0104
Kogia spp.	0.01005	350,553	North Pacific	0.0373	0.0315
Cuvier's beaked whale	0.0062	90,725	North Pacific	0.0690	0.0679
Blainville's beaked whale	0.00117	8,032	North Pacific	0.1471	0.1446
Ginkgo-toothed beaked whale	0.0005	22,799	North Pacific	0.0222	0.0218
Longman's beaked whale	0.00041	1,007	Central North Pacific	0.4112	0.4043
False killer whale	0.00111	16,668	Western North Pacific	0.0699	0.0440
Pygmy killer whale	0.00014	30,214	Western North Pacific	0.0049	0.0031
Melon-headed whale	0.00428	36,770	Western North Pacific	0.1222	0.0769
Killer whale	0.00014	349	Hawaii	0.4894	0.4372
Short-finned pilot whale	0.00159	53,608	Western North Pacific	0.0350	0.0205
Risso's dolphin	0.00097	83,289	Western North Pacific	0.0141	0.0125
Common dolphin	0.0021	3,286,163	Western North Pacific	0.0007	0.0006
Bottlenose dolphin	0.00021	168,791	Western North Pacific	0.0013	0.0009
Spinner dolphin	0.0031	1,015,059	Western North Pacific	0.0027	0.0025
Pantropical spotted dolphin	0.0226	438,064	Western North Pacific	0.0444	0.0417
Striped dolphin	0.00616	570,038	Western North Pacific	0.0093	0.0087
Rough-toothed dolphin	0.00029	145,729	Western North Pacific	0.0022	0.0021
Fraser's dolphin	0.00417	10,226	Hawaii	0.4119	0.3780

Table C-21. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 5, Sea of Japan, in fall.

OPAREA 5 (FALL): SEA OF JAPAN				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE
Fin whale	0.0009	9,250	North Pacific Stock	0.2345
Bryde's whale	0.0001	20,501	Western North Pacific	0.0104
Common minke whale	0.0004	25,049	Western North Pacific	0.0291
Common minke whale J stock	0.0002	893	J-stock	0.3261
Gray whale	0.00001	121	Western North Pacific	0.0011
North Pacific right whale (spring/fall/winter)	0.00001	922	Western North Pacific	0.0255
Sperm whale	0.0008	102,112	North Pacific Stock	0.0206
Stejneger's beaked whale	0.0014	8,000	North Pacific Stock	0.5023
Baird's beaked whale	0.0003	8,000	Western North Pacific	0.1076
Cuvier's beaked whale	0.0043	90,725	North Pacific Stock	0.1360
Gingko-toothed beaked whale	0.0005	22,799	North Pacific Stock	0.0629
False killer whale	0.0027	9,777	Inshore archipelago	0.8202
Melon-headed whale	0.00001	36,770	Western North Pacific	0.0008
Short-finned pilot whale	0.0014	53,608	Western North Pacific	0.0303
Risso's dolphin	0.0073	83,289	Western North Pacific	0.2121
Common dolphin	0.0860	3,286,163	Western North Pacific	0.0529
Bottlenose dolphin	0.0009	105,138	inshore archipelago	0.0134
Spinner dolphin	0.00001	1,015,059	Western North Pacific	< 0.0001
Pantropical spotted dolphin	0.0137	219,032	Western North Pacific	0.0632
Pacific white-sided dolphin	0.0030	931,000	Western North Pacific	0.0040
Dall's porpoise	0.0520	76,720	Sea of Japan Stock	0.9218

Table C-22. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 6, East China Sea, in summer.

OPAREA 6 (SUMMER): EAST CHINA SEA				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE
Fin whale	0.0002	500	East China Sea Stock	0.6200
Bryde's whale	0.0006	20,501	Western North Pacific	0.0357
Common minke whale	0.0044	25,049	Western North Pacific	0.2284
Common minke whale J stock	0.0018	893	J-stock	2.6204
Gray whale (winter only)	0.0	121	Western North Pacific	< 0.0001
North Pacific right whale (winter)	0.0	922	Western North Pacific	< 0.0001
Sperm whale	0.0012	102,112	North Pacific	0.0092
Kogia spp.	0.0031	350,553	North Pacific	0.0056
Cuvier's beaked whale	0.0062	90,725	North Pacific	0.0719
Blainville's beaked	0.0012	8,032	North Pacific	0.1530
Ginkgo-toothed beaked whale	0.0005	22,799	North Pacific	0.0230
False killer whale	0.0011	9,777	Inshore archipelago	0.1703
Pygmy killer whale	0.0001	30,214	Western North Pacific	0.0070
Melon-headed whale	0.0043	36,770	Western North Pacific	0.1746
Short-finned pilot whale	0.0016	53,608	Western North Pacific	0.0498
Risso's dolphin	0.0106	83,289	Western North Pacific	0.1833
Common dolphin	0.0461	3,286,163	Western North Pacific	0.0202
Bottlenose dolphin	0.0146	105,138	inshore archipelago	0.0967
Spinner dolphin	0.0031	1,015,059	Western North Pacific	0.0036
Pantropical spotted dolphin	0.0137	219032	Western North Pacific	0.0728
Striped dolphin	0.0164	570,038	Western North Pacific	0.0334
Rough-toothed dolphin	0.0059	145,729	Western North Pacific	0.0518
Fraser's dolphin	0.0040	220,789	Western North Pacific	0.0252
Pacific white-sided dolphin	0.0028	931,000	Western North Pacific	0.0041

Table C-23. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 7, South China Sea, in fall.

OPAREA 7 (FALL): SOUTH CHINA SEA				
SPECIES	DENSITY (KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE
Fin whale	0.0002	9,250	Western North Pacific	0.0352
Bryde's whale	0.0006	20,501	Western North Pacific	0.0416
Common minke whale	0.0033	25,049	Western North Pacific	0.1713
Gray whale (winter only)	0.0	121	Western North Pacific	< 0.0001
North Pacific right whale (winter)	0.0	922	Western North Pacific	< 0.0001
Sperm whale	0.0012	102,112	North Pacific	0.0125
Kogia spp.	0.0017	350,553	North Pacific	0.0087
Cuvier's beaked whale	0.0003	90,725	North Pacific	0.0042
Blainville's beaked whale	0.0005	8,032	North Pacific	0.0782
Gingko-toothed beaked whale	0.0005	22,799	North Pacific	0.0276
False killer whale	0.0011	9,777	Inshore archipelago	0.1873
Pygmy killer whale	0.0001	30,214	Western North Pacific	0.0076
Melon-headed whale	0.0043	36,770	Western North Pacific	0.1921
Short-finned pilot whale	0.0016	53,608	Western North Pacific	0.0415
Risso's dolphin	0.0106	83,289	Western North Pacific	0.2074
Common dolphin	0.0461	3,286,163	Western North Pacific	0.0210
Bottlenose dolphin	0.0146	105,138	Inshore archipelago	0.0796
Spinner dolphin	0.3140	1,015,059	Western North Pacific	0.3186
Pantropical spotted dolphin	0.0137	219,032	Western North Pacific	0.0646
Striped dolphin	0.0164	570,038	Western North Pacific	0.0296
Rough-toothed dolphin	0.0040	145,729	Western North Pacific	0.0467
Fraser's dolphin	0.0040	220,789	Western North Pacific	0.0257

Table C-24. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 8, NW Pacific, in summer.

OPAREA 8 (SUMMER): NW PACIFIC (25°N TO 40°N)				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE
Blue whale	0.0003	9,250	North Pacific Stock	0.1064
Fin whale	0.0001	9,250	North Pacific Stock	0.0532
Sei whale	0.00029	37,000	North Pacific Stock	0.0400
Bryde's whale	0.00041	20,501	Western North Pacific Stock	0.1020
Common minke whale	0.0003	25,049	Western North Pacific Stock	0.0465
Sperm whale	0.0003	102,112	North Pacific Stock	0.0054
Kogia spp.	0.0049	350,553	North Pacific Stock	0.0587
Baird's beaked whale	0.0001	8,000	Western North Pacific Stock	0.0283
Cuvier's beaked whale	0.0017	90,725	North Pacific Stock	0.0423
Mesoplodon spp	0.0005	22,799	North Pacific Stock	0.0711
False killer whale	0.0036	16,668	Western North Pacific Stock	0.6998
Pygmy killer whale	0.00014	30,214	Western North Pacific Stock	0.0150
Melon-headed whale	0.0012	36,770	Western North Pacific Stock	0.1057
Short-finned pilot whale	0.00005	53,608	Western North Pacific Stock	0.0014
Risso's dolphin	0.001	83,289	Western North Pacific Stock	0.0418
Common dolphin	0.0863	3,286,163	Western North Pacific Stock	0.1140
Bottlenose dolphin	0.0005	168,791	Western North Pacific Stock	0.0086
Spinner dolphin	0.00001	1,015,059	Western North Pacific Stock	< 0.0001
Pantropical spotted dolphin	0.0181	438,064	Western North Pacific Stock	0.0696
Striped dolphin	0.05	570,038	Western North Pacific Stock	0.1477
Rough-toothed dolphin	0.00029	145,729	Western North Pacific Stock	0.0076
Pacific white-sided dolphin	0.0048	67,769	Western North Pacific Stock	0.1544
Hawaiian monk seal	0.00001	1,129	Hawaiian Stock	

Table C-25. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 9, NW Pacific, in winter.

OPAREA 9 (WINTER): NW PACIFIC (10°N TO 25°N)				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 dB SPE
Bryde's whale	0.00041	20,501	Western North Pacific Stock	0.0309
Sperm whale	0.0004	102,112	North Pacific	0.0034
Kogia spp.	0.0009	350,553	North Pacific	0.0044
Cuvier's beaked whale	0.0017	90,725	North Pacific	0.0197
False killer whale	0.0021	16,668	Western North Pacific Stock	0.1965
Melon-headed whale	0.0012	36,770	Western North Pacific Stock	0.0509
Short-finned pilot whale	0.0009	53,608	Western North Pacific Stock	0.0373
Risso's dolphin	0.0026	83,289	Western North Pacific Stock	0.0478
Common dolphin	0.0863	3,286,163	Western North Pacific Stock	0.0475
Bottlenose dolphin	0.0007	168,791	Western North Pacific Stock	0.0074
Spinner dolphin	0.00314	1,015,059	Western North Pacific Stock	0.0054
Pantropical spotted dolphin	0.0226	438,064	Western North Pacific Stock	0.0908
Striped dolphin	0.011	570,038	Western North Pacific Stock	0.0340
Rough-toothed dolphin	0.00029	145,729	Western North Pacific Stock	0.0027

Table C-26. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 10, Hawaii North, in summer.

OPAREA 10 (SUMMER): HAWAII NORTH (25°N TO 158°W)				
SPECIES	**DENSITY (/KM^2)**	**# IN STOCK**	**STOCK**	**% STOCK AFFECTED <180 DB SPE**
Blue whale	0.0002	1548	Western North Pacific stock	0.2295
Fin whale	0.0007	2099	Hawaii stock	0.9338
Bryde's whale	0.0002	469	Hawaii stock	1.1855
Common minke whale	0.0002	25000	Hawaii stock	0.0128
Humpback whale (summer)	0.0	10103	Hawaii stock	< 0.0001
Sperm whale	0.0028	6919	Central North Pacific stock	0.5258
Kogia spp.	0.0101	24657	Hawaii stock	1.0271
Cuvier's beaked whale	0.0062	15242	Hawaii stock	0.6698
Blainville's beaked	0.0012	2872	Hawaii stock	0.6697
Longman's beaked whale	0.0004	1007	Hawaii stock	0.6530
Killer whale	0.0001	349	Hawaii stock	0.7851
False killer whale	0.0002	484	Hawaii stock pelagic	0.8760
Pygmy killer whale	0.0004	956	Hawaii stock	0.8870
Melon-headed whale	0.0012	2950	Hawaii stock	0.8624
Short-finned pilot whale	0.0036	8870	Hawaii stock	0.3718
Risso's dolphin	0.0010	2372	Hawaii stock	0.9106
Bottlenose dolphin	0.0013	3215	Hawaii stock	0.5087
Spinner dolphin	0.0014	3351	Hawaii stock	0.2347
Pantropical spotted dolphin	0.0037	8978	Hawaii stock	0.2340
Striped dolphin	0.0054	13143	Hawaii stock	0.2341
Rough-toothed dolphin	0.0036	8709	Hawaii stock	0.9375
Fraser's dolphin	0.0042	10226	Hawaii stock	0.7590
Hawaiian monk seal	0.0001	1129	Hawaii stock	0.1435

Table C-27. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 11, Hawaii South, in spring and fall.

OPAREA 11 (Spring/Fall): Hawaii South (19.5°N to 158.5°W)				
Species	**Density (/km^2)**	**# in Stock**	**Stock**	**% Stock Affected <180 dB SPE**
Blue whale	0.0002	1,548	Western North Pacific stock	0.1288
Fin whale	0.0007	2,099	Hawaii stock	0.4369
Bryde's whale	0.0002	469	Hawaii stock	0.5544
Common minke whale	0.0002	25,000	Hawaii stock	0.0078
Humpback whale (not summer)	0.0008	10,103	Hawaii stock	0.0003
Sperm whale	0.0028	6,919	Central North Pacific stock	0.3391
Kogia spp.	0.0101	24,657	Hawaii stock	0.5217
Cuvier's beaked whale	0.0062	15,242	Hawaii stock	0.3985
Blainville's beaked	0.0012	2,872	Hawaii stock	0.3984
Longman's beaked whale	0.0004	1,007	Hawaii stock	0.3885
Killer whale	0.0001	349	Hawaii stock	0.3811
False killer whale	0.0002	484	Hawaii stock pelagic	0.4628
Pygmy killer whale	0.0004	956	Hawaii stock	0.4686
Melon-headed whale	0.0012	2,950	Hawaii stock	0.4556
Short-finned pilot whale	0.0036	8,870	Hawaii stock	0.3527
Risso's dolphin	0.0010	2,372	Hawaii stock	0.4764
Bottlenose dolphin	0.0013	3,215	Hawaii stock	0.3514
Spinner dolphin	0.0014	3,351	Hawaii stock	0.2935
Pantropical spotted dolphin	0.0037	8,978	Hawaii stock	0.2927
Striped dolphin	0.0054	13,143	Hawaii stock	0.2928
Rough-toothed dolphin	0.0036	8,709	Hawaii stock	0.4932
Fraser's dolphin	0.0042	10,226	Hawaii stock	0.4037
Hawaiian monk seal	0.0001	1,129	Hawaii stock	0.1010

Table C-28. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 12, Offshore Southern California, in spring.

OPAREA 12 (Spring): Offshore Southern California				
Species	Density (/km^2)	# in Stock	Stock	% Stock Affected <180 dB SPE
Common minke whale	0.00072	823	CA/OR/WA	1.2685
Sei whale	0.00009	98	Eastern North Pacific	1.9876
Bryde's whale	0.000008	13,000	Eastern tropical Pacific	0.0013
Blue whale	0.00136	2,842	Eastern North Pacific	0.8374
Fin whale	0.00184	2,099	CA/OR/WA	2.2178
Humpback whale	0.00083	942	CA/OR/WA	1.0485
Gray whale	0.051	18,813	Eastern North Pacific	0.0352
Short-finned pilot whale	0.00031	350	CA/OR/WA	1.5433
Killer whale	0.00071	810	Eastern North Pacific offshore	1.9898
Pygmy sperm whale	0.00109	1,237	CA/OR/WA	2.5818
Sperm whale	0.0017	1,934	CA/OR/WA	1.9354
Baird's beaked whale	0.00088	1,005	CA/OR/WA	1.9439
Longman's beaked whale	0.00103	1,177	Hawaii	1.9427
Hubb's beaked whale	0.00103	1,177	CA/OR/WA	1.9427
Blainville's beaked whale	0.00103	1,177	CA/OR/WA	1.9427
Ginkgo-toothed beaked whale	0.00103	1,177	CA/OR/WA	1.9427
Perrin's beaked whale	0.00103	1,177	CA/OR/WA	1.9427
Pygmy beaked whale	0.00103	1,177	CA/OR/WA	1.9427
Stejneger's beaked whale	0.00103	1,177	CA/OR/WA	1.9427
Cuvier's beaked whale	0.00382	4,342	CA/OR/WA	1.9531
Long-beaked common dolphin	0.01924	21,902	CA/OR/WA	1.8887
Short-beaked common dolphin	0.30935	352,069	CA/OR/WA	1.8891
Risso's dolphin	0.01046	11,910	CA/OR/WA	2.3572
Pacific white-sided dolphin	0.02093	23,817	CA/OR/WA	1.0370
Northern right whale dolphin	0.00975	11,097	CA/OR/WA	2.4777
Striped dolphin	0.01667	18,976	CA/OR/WA	1.0087
Bottlenose dolphin	0.00178	2,026	CA/OR/WA offshore	1.4497

Table C-28. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 12, Offshore Southern California, in spring.

OPAREA 12 (Spring): Offshore Southern California				
Species	**Density (/km^2)**	**# in Stock**	**Stock**	**% Stock Affected <180 dB SPE**
Dall's porpoise	0.07553	85,955	CA/OR/WA	0.9666
Guadalupe fur seal	0.007	7,408	Mexico	0.7172
Northern fur seal	0.0	9,424	San Miguel Island	< 0.0001
California sea lion (on shelf)	0.54	238,000	California	0.9507
California sea lion (offshore)	0.0	238,000	California	< 0.0001
Northern elephant seal (on shelf)	0.0045	124,000	California breeding	0.0191
Northern elephant seal (offshore)	0.0	124,000	California breeding	< 0.0001
Harbor seal	0.0095	34,233	California	0.2559

Table C-29. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 13, Western Atlantic, in winter.

OPAREA 13 (WINTER): WESTERN ATLANTIC (JAX OPAREA)				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 dB SPE
Humpback whale	0.000581	11,570	Western North Atlantic	0.0663
North Atlantic right whale (on shelf)	0.00124	438	Western North Atlantic	0.1217
Short-finned pilot whale (on shelf)	0.00004	31,139	Western North Atlantic	0.0001
Short-finned pilot whale (off shelf)	0.027125	31,139	Western North Atlantic	2.2997
Pygmy sperm whale	0.00101	580	Western North Atlantic	4.4579
Dwarf sperm whale	0.00101	580	Western North Atlantic	4.4579
Sperm whale (on shelf)	0.0	4,804	Western North Atlantic	< 0.0001
Sperm whale (off shelf)	0.000467	4,804	Western North Atlantic	0.1691
Beaked whales (on shelf)	0.0	3,513	Western North Atlantic	< 0.0001
Blainville's beaked whale (off shelf)	0.000621	3,513	Western North Atlantic	0.3642
Gervais' beaked whale (off shelf)	0.000621	3,513	Western North Atlantic	0.3642
Cuvier's beaked whale (off shelf)	0.000621	3,513	Western North Atlantic	0.3642
True's beaked whale (off shelf)	0.000621	3,513	Western North Atlantic	0.3642
Sowerby's beaked whale (off shelf)	0.000621	3,513	Western North Atlantic	0.3642
Rough-toothed dolphin	0.00048	274	Western North Atlantic	2.5226
Bottlenose dolphin (on shelf)	0.213192	81,588	Western North Atlantic	0.1150
Bottlenose dolphin (off shelf)	0.116286	81,588	Western North Atlantic	2.8506
Risso's dolphin (on shelf)	0.0009	20,479	Western North Atlantic	0.0054
Risso's dolphin (off shelf)	0.018051	20,479	Western North Atlantic	1.9744
Common dolphin	0.00002	120,743	Western North Atlantic	0.0003
Pantropical spotted dolphin	0.02225	12,747	Western North Atlantic	2.8452
Clymene dolphin	0.01063	60,86	Western North Atlantic	2.8470
Striped dolphin	0.000032	94,462	Western North Atlantic	0.0006
Atlantic spotted dolphin (on shelf)	0.4435	50,978	Western North Atlantic	0.4089
Atlantic spotted dolphin (off shelf)	0.0041	50,978	Western North Atlantic	0.1311

Table C-30. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 14, Eastern North Atlantic, in summer.

OPAREA 14 (SUMMER): EASTERN NORTH ATLANTIC (NW APPROACHES)				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 dB SPE
Common minke whale	0.0068	107,205	Eastern North Atlantic	0.6518
Sei whale	0.0113	14,152	Eastern North Atlantic	9.2473
Blue whale	0.00001	100	Eastern North Atlantic	0.7726
Fin whale	0.0031	10,369	Eastern North Atlantic	3.4018
Humpback whale	0.0019	4,695	Eastern North Atlantic	1.1710
Sperm whale	0.0049	6,375	Eastern North Atlantic	2.3498
False killer whale	0.0001	484	Eastern North Atlantic	1.2615
Long-finned pilot whale	0.012144	778,000	Eastern North Atlantic	0.0857
Killer whale	0.0001	6,618	Eastern North Atlantic	0.1607
North Atlantic bottlenose whale	0.00026	5,827	Eastern North Atlantic	0.1654
Sowerby's beaked whale	0.001297	3,513	Eastern North Atlantic	1.3685
Blainville's beaked whale	0.001297	3,513	Eastern North Atlantic	1.3685
Cuvier's beaked whale	0.001297	3,513	Eastern North Atlantic	1.3685
Pygmy sperm whale	0.000101	580	Eastern North Atlantic	1.3386
Dwarf sperm whale	0.000101	580	Eastern North Atlantic	1.3386
Harbor porpoise	0.2299	341,366	Eastern North Atlantic	1.4294
Common dolphin	0.238	273,150	Eastern North Atlantic	9.1833
Risso's dolphin	0.0063	20,479	Eastern North Atlantic	2.1137
Striped dolphin	0.076523	94,462	Eastern North Atlantic	4.8839
Bottlenose dolphin	0.009397	81,588	Eastern North Atlantic	1.0419
Atlantic white-sided dolphin	0.0027	11,760	Eastern North Atlantic	1.4759
White-beaked dolphin	0.0027	11,760	Eastern North Atlantic	1.4759
Harbor seal	0.022946	23,500	Ireland/Scotland stock	3.2031
Gray seal	0.027	113,300	Eastern North Atlantic	3.7559

Table C-31. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 15, Mediterranean Sea, in summer.

OPAREA 15 (SUMMER): MEDITERRANEAN SEA, LIGURIAN SEA				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE
Fin whale	0.004	3,583	Mediterranean	7.0332
Sperm whale	0.0049	6,375	Western Mediterranean	1.7525
Cuvier's beaked whale	0.0013	3,513	Eastern North Atlantic	1.0139
Long-finned pilot whale	0.0121	778,000	Eastern North Atlantic	0.0754
Risso's dolphin	0.0075	5,320	Western Mediterranean	6.7105
Striped dolphin	0.24	117,880	Western Mediterranean	8.8565
Bottlenose dolphin	0.041	23,304	Western Mediterranean	10.3802
Common dolphin	0.0144	19,428	Western Mediterranean	4.4472

Table C-32. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 16, Arabian Sea, in summer.

OPAREA 16 (SUMMER): ARABIAN SEA				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE
Bryde's whale	0.0001	9,176	Indian Ocean	0.0134
Humpback whale	0.0004	200	Stock X / Arabian Sea	1.5275
Sperm whale	0.0125	24,446	Indian Ocean	0.4530
Pygmy killer whale	0.0026	22,029	Indian Ocean	0.3187
Melon-headed whale	0.0661	64,600	Indian Ocean	2.7627
False killer whale	0.0003	144,188	Indian Ocean	0.0056
Dwarf sperm whale	0.0145	10,541	Indian Ocean	4.1267
Longman's beaked whale	0.0016	16,867	Indian Ocean	0.1880
Blainville's beaked whale	0.0016	16,867	Indian Ocean	0.1880
Ginkgo-toothed beaked whale	0.0016	16,867	Indian Ocean	0.1880
Cuvier's beaked whale	0.0001	27,272	Indian Ocean	0.0073
Common dolphin	0.0265	1,819,882	Indian Ocean	0.0373
Risso's dolphin	0.0125	452,125	Indian Ocean	0.0357
Rough-toothed dolphin	0.0081	156,690	Indian Ocean	0.0663
Bottlenose dolphin	0.0164	785,585	Indian Ocean	0.0393
Pantropical spotted dolphin	0.0127	736,575	Indian Ocean	0.0072
Striped dolphin	0.0706	674,578	Indian Ocean	0.0437
Spinner dolphin	0.0100	634,108	Indian Ocean	0.0066
Short-finned pilot whale	0.0034	268,751	Indian Ocean	0.0078

Table C-33. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 17, Andaman Sea, in summer.

OPAREA 17 (SUMMER): ANDAMAN SEA				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE
Bryde's whale	0.0001	9,176	Indian Ocean	0.0094
Sperm whale	0.0125	24,446	Indian Ocean	0.5369
Short-finned pilot whale	0.0034	268,751	Indian Ocean	0.0079
Killer whale	0.0001	12,593	Indian Ocean	0.0079
Dwarf sperm whale	0.0145	10,541	Indian Ocean	1.5682
Pygmy killer whale	0.0026	22,029	Indian Ocean	0.0970
Melon-headed whale	0.0661	64,600	Indian Ocean	0.8411
False killer whale	0.0003	144,188	Indian Ocean	0.0017
Longman's beaked whale	0.0016	16,867	Indian Ocean	0.1214
Blainville's beaked whale	0.0016	16,867	Indian Ocean	0.1214
Ginkgo-toothed beaked whale	0.0016	16,867	Indian Ocean	0.1214
Cuvier's beaked whale	0.0001	27,272	Indian Ocean	0.0047
Common dolphin	0.0265	1,819,882	Indian Ocean	0.0130
Risso's dolphin	0.0125	452,125	Indian Ocean	0.0337
Pantropical spotted dolphin	0.0127	736,575	Indian Ocean	0.0104
Striped dolphin	0.0706	674,578	Indian Ocean	0.0632
Spinner dolphin	0.0100	634,108	Indian Ocean	0.0095
Rough-toothed dolphin	0.0081	156,690	Indian Ocean	0.0724
Bottlenose dolphin	0.0164	785,585	Indian Ocean	0.0122

Table C-34. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 18, Panama Canal, in winter.

OPAREA 18 (WINTER): PANAMA CANAL (WESTERN APPROACHES)				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE
Bryde's whale	0.0003	13,000	Eastern Tropical Pacific	0.0197
Blue whale	0.0001	2,842	Eastern North Pacific	0.0287
Humpback whale	0.0004	1,391	Eastern North Pacific	0.0034
Killer whale	0.0002	8,500	Eastern Tropical Pacific	0.0116
Short-finned pilot whale	0.0058	160,200	Eastern Tropical Pacific	0.0288
Dwarf sperm whale	0.0145	11,200	Eastern Tropical Pacific	1.711
Pygmy killer whale	0.0014	38,900	Eastern Tropical Pacific	0.0316
Melon-headed whale	0.0174	45,400	Eastern Tropical Pacific	0.3324
False killer whale	0.0004	39,800	Eastern Tropical Pacific	0.0082
Sperm whale	0.0047	22,700	Eastern Tropical Pacific	0.1604
Longman's beaked whale	0.0003	25,300	Eastern Tropical Pacific	0.0112
Blainville's beaked whale	0.0013	25,300	Eastern Tropical Pacific	0.0502
Ginkgo-toothed beaked whale	0.0016	25,300	Eastern Tropical Pacific	0.0617
Pygmy beaked whale	0.0016	25,300	Eastern Tropical Pacific	0.0617
Cuvier's beaked whale	0.0025	20,000	Eastern Tropical Pacific	0.1204
Common dolphin	0.0490	3,127,203	Eastern Tropical Pacific	0.0153
Risso's dolphin	0.0161	110,457	Eastern Tropical Pacific	0.1724
Pantropical spotted dolphin	0.0669	640,000	Northeastern Offshore Pacific	0.0549
Striped dolphin	0.1199	964,362	Eastern Tropical Pacific	0.0653
Spinner dolphin	0.0070	450,000	Eastern Stock	0.0082
Rough-toothed dolphin	0.0146	107,633	Eastern Tropical Pacific	0.1744
Bottlenose dolphin	0.0157	335,834	Eastern Tropical Pacific	0.0363
Fraser's dolphin	0.001	289,300	Eastern Tropical Pacific	0.0030

Table C-35. Estimates of the percentages of marine mammal stocks potentially affected for SURTASS LFA sonar potential OPAREA 19, Northeast Australia, in spring.

OPAREA 19 (SPRING): NORTHEAST AUSTRALIA COAST				
SPECIES	DENSITY (/KM^2)	# IN STOCK	STOCK	% STOCK AFFECTED <180 DB SPE
Common minke whale	0.0044	25,000	Western South Pacific	0.2466
Bryde's whale	0.0006	22,000	Western South Pacific	0.0389
Blue whale	0.0002	9,250	Western South Pacific	0.0311
Fin whale	0.0002	9,250	Western South Pacific	0.0392
Humpback whale inshore (<200 m)	0.0143	3,500	Group V East Australia	7.1143
Humpback whale offshore (>200 m)	0.0004	3,500	Group V East Australia	0.1990
Killer whale	0.0004	12,256	Western South Pacific	0.0594
Short-finned pilot whale	0.0153	53,608	Western South Pacific	0.5580
Long-finned pilot whale	0.0153	53,608	Western South Pacific	0.5580
Pygmy sperm whale	0.0031	350,553	Western South Pacific	0.0187
Dwarf sperm whale	0.0031	350,553	Western South Pacific	0.0187
Sperm whale	0.0029	102,112	Western South Pacific	0.0367
Pygmy killer whale	0.0021	30,214	Western South Pacific	0.1768
Melon-headed whale	0.0012	36,770	Western South Pacific	0.0830
False killer whale	0.0029	16,668	Western South Pacific	0.4427
Southern bottlenose whale	0.0005	22,799	Western South Pacific	0.0375
Longman's beaked whale	0.0005	22,799	Western South Pacific	0.0375
Blainville's beaked whale	0.0005	8,032	Western South Pacific	0.1065
Ginkgo-toothed beaked whale	0.0005	22,799	Western South Pacific	0.0375
Arnoux's beaked whale	0.0005	22,799	Western South Pacific	0.0375
Cuvier's beaked whale	0.0054	90,725	Western South Pacific	0.1018
Common dolphin	0.0562	3,286,163	Western South Pacific	0.0265
Risso's dolphin	0.0106	83,289	Western South Pacific	0.2586
Fraser's dolphin	0.004	220,789	Western South Pacific	0.0280
Dusky dolphin	0.0002	12,626	Western South Pacific	0.0228
Pantropical spotted dolphin	0.0137	438,064	Western South Pacific	0.0400
Striped dolphin	0.0329	570,038	Western South Pacific	0.0738
Spinner dolphin	0.0005	1,015,059	Western South Pacific	0.0006
Rough-toothed dolphin	0.0059	145,729	Western South Pacific	0.0837
Bottlenose dolphin	0.0146	168,791	Western South Pacific	0.1438

Literature Cited

Airoldi, S., F. Bendinoni, A. Azzellino, V. Fadda, and A. Profice. 2005. Abundance estimate of Risso's dolphins (*Grampus griseus*) in the western Ligurian Sea through photographic mark-recapture. Nineteenth Annual Conference of the European Cetacean Society, La Rochelle, France.

Allen, B. M. and R. P. Angliss. 2010. Alaska marine mammal stock assessments, 2009. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-206. 276 p.

Alves, F., L. Freitas and A. Dinis. 2006. Occurrence and diving behaviour of false killer whale off Madeira archipelago (NE Atlantic). ECS 2006*.* Gydnia, Poland.

Amano, M. and M. Yoshioka. 2003. Sperm whale diving behavior monitored using a suction-cup-attached TDR tag. Marine Ecology Progress Series 258: 291-295.

American Academy of Ophthalmology and Otolaryngology. 1969. Guide for conservation of hearing in noise.

Anderson, R. C., R. Clark, P. T. Madsen, C. Johnson, J. Kiszka and O. Breysse. 2006. Observations of Longman's Beaked Whale (*Indopacetus pacificus*) in the Western Indian Ocean. Aquatic Mammals 32(2): 223-231.

ANSI (American National Standard Institute). 2006. ANSI reference quantities for acoustical levels, ANSI-S1-8-1989, revised 2006. New York, New York: Acoustic Society of America.

Aoki, K., M. Amano, M. Yoshioka, K. Mori, D. Tokuda and N. Miyazaki. 2007. Diel diving behavior of sperm whales off Japan Marine Ecology Progress Series 349: 277-287.

Archer, F. I., II and W. F. Perrin. 1999. Stenella coeruleoalba. Mammalian Species 603: 1-9.

Baba, N., A. I. Boltnev and A. I. Stus. 2000. Winter migration of female northern fur seals *Callorhinus ursinus* from the Commander Islands. Bulletin of the National Research Institute of Far Seas Fisheries 37: 39-44.

Bain, D., E., J. C. Smith, R. Williams and D. Lusseau. 2005. Effects of Vessels on behavior of southern resident killer whales (*Orcinus* spp.). 15th Biennial Conference on the Biology of Marine Mammals*.*

Baird, R. W. 1994. Foraging behavior and ecology of transient killer whales (*Orcinus orca*). degree of Doctor of Philosophy in Biological Sciences, Simon Fraser University. 159 pp.

Baird, R. W. 2005. Sightings of dwarf (*Kogia sima*) and pygmy (*K. breviceps*) sperm whales from the main Hawaiian Islands. Pacific Science 59(3): 461-466.

Baird, R. W., J. F. Borsani, M. B. Hanson and P. L. Tyack. 2002. Diving and night-time behavior of long-finned pilot whales in the Ligurian Sea. Marine Ecology Progress Series 237: 301-305.

Baird, R. W., M. B. Hanson and L. M. Dill. 2005. Factors influencing the diving behaviour of fish-eating killer whales: sex differences and diel and interannual variation in diving rates. Canadian Journal of Zoology 83(2): 257-267.

Baird, R. W., A. D. Ligon and S. K. Hooker. 2000. Sub-surface and night-time behavior of humpback whales off Maui, Hawaii: a preliminary report.

Baird, R. W., A. D. Ligon, S. K. Hooker and A. M. Gorgone. 2001. Subsurface and nighttime behaviour of pantropical spotted dolphins in Hawai'i. Canadian Journal of Zoology 79: 988-996.

Baker, C. S. and L. M. Herman. 1989. The behavioral responses of summering humpback whales to vessel traffic: Experimental and opportunistic observations. Kewalo Basin Marine Mammal Laboratory, Honolulu, June, 1989.

Ballance, L. T. and R. L. Pitman. 1998. Cetaceans of the western tropical Indian Ocean: Distribution, relative abundance, and comparisons with cetacean communities of two other tropical ecosystems. Marine Mammal Science 14(3):429-459.

Barlow, J. 1995. The abundance of cetaceans in California waters: Part I. Ship surveys in summer and fall of 1991. U S National Marine Fisheries Service Fishery Bulletin 93(1): 1-14.

Barlow, J. 2006. Cetacean abundance in Hawaiian waters estimated from a summer/fall survey in 2002. Marine Mammal Science 22(2):446-464.

Barlow, J., and K. Forney. 2007. Abundance and population density of cetaceans in the California Current ecosystem. Fishery Bulletin 105**:** 509-526.

Barlow, J., M. C. Ferguson, W. F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C. D. MacLeod, K. Mullin, D. L. Palka, and G. Waring. 2006. Abundance and densities of beaked and bottlenose whales (family Ziphiidae). Journal of Cetacean Research and Management 7(3):263-270.

Barlow J. and S. Rankin. 2007. False killer whate abundance and density: Preliminary estimates for the Piceas study area south of Hawaii and new estimates for the EEZ around Hawaii. NOAA Southwest Fisheries Science Center, Administartive Report LJ-07-02. La Jolla, California

Bauer, G. B., J. R. Mobley, A. S. Frankel, D. A. Helweg, and L. M. Herman. 1995. Behavior characteristics of humpback whales in Hawaii. Eleventh Biennial conference on the Biology of Marine Mammals, Orlando, Florida.

Baumgartner, M. F. and B. R. Mate. 2003. Summertime foraging ecology of North Atlantic right whales. Marine Ecology-Progress Series 264: 123-135.

Baumgartner, M. F., K. D. Mullin, L. N. May and T. D. Leming. 2001. Cetacean habitats in the northern Gulf of Mexico. Fishery Bulletin Seattle 99(2): 219-239.

Benoit-Bird, K. J. and W. W. L. Au. 2003. Prey dynamics affect foraging by a pelagic predator (*Stenella longirostris*) over a range of spatial and temporal scales. Behavioral Ecology and Sociobiology 53(6): 364-373.

Beranek, L.L. 1954. Acoustics. New York, New York: McGraw-Hill.

Best, P. B., J. L. Bannister, R. L. Brownell, Jr. and G. P. Donovan, Eds. 2001. Right whales: Worldwide status. Journal of Cetacean Research and Management (Special Issue 2)**:** 1-309.

Bishop, G. C., W. T. Ellison and L. E. Mellberg. 1987. A simulation model for high-frequency under-ice reverberation. Journal of the Acoustical Society of America 82(1): 275-285.

Bowen, W., D. Boness and S. Iverson. 1999. Diving behaviour of lactating harbour seals and their pups during maternal foraging trips. Canadian Journal of Zoology 77: 978-988.

Bowles, A.E., M. Smultea, B. Würsig, D.P. DeMaster, and D. Palka. 1994. Relative abundance and behavior of marine mammals exposed to transmissions from the Heard Island Feasibility Test. Journal of the Acoustical Society of America 96(4):2469-2484.

Brown, S. G. 1977. Some results of sei whale marking in the southern hemisphere. Report of the International Whaling Commission Si1: 39-43.

Buck, J.R., and P.L. Tyack. 2000. Response of gray whales to low-frequency sounds. Journal of the Acoustical Society of America 107(5, pt. 2):2774-2774.

Buckland, S.T., K. L. Cattanach, and T. Miyashita. 1992. Minke whale abundance in the northwest Pacific and the Okhotsk Sea, estimated from 1989 and 1990 sighting surveys. Report of the International Whaling Commission 42:387-392.

Buckland, S.T., K. L. Cattanach, and R. C. Hobbs. 1993a. Abundance estimates of Pacific white-sided dolphin, northern right whale dolphin, Dall's porpoise and northern fur seal in the North Pacific, 1987-1990. International North Pacific Fisheries Commission Bulletin 53:387-407.

Buckland, S. T., D. Bloch, K. L. Cattanach, T. Gunnlaugsson, K. Hoydal, S. Lens, and J. Sigurjónsson. 1993b. Distribution and abundance of long-finned pilot whales in the North Atlantic estimated from NASS-1987 and NASS-89 data. Report of the International Whaling Commission Special Issue 14:33-50.

Burgess, W. C., P. L. Tyack, B. J. LeBoeuf and D. P. Costa. 1998. A programmable acoustic recording tag and first results from free-ranging northern elephant seals. Deep Sea Research Part II: Topical Studies in Oceanography 45(7): 1327-1351.

Calambokidis, J., E.A. Falcone, T.J. Quinn, A.M. Burdin, P.J. Clapham, J.K.B. Ford, C.M. Gabriele, R. Leduc, D. Mattila, L. Rojas-, J. M. S. Bracho, B.L. Taylor, J. Urbán R., D. Weller, B.H. Witteveen, M. Yamaguchi, A. Bendlin, D. Camacho, K. Flynn, A. and J. H. Havron, and N. Maloney. 2008. SPLASH: Structure of populations, levels of abundance and status of humpback whales in the North Pacific. Final report for Contract AB133F-03-RP-00078. Report prepared for U.S. Dept of Commerce, Western Administrative Center, Seattle, Washington. Cascadia Research, Olympia, Washington.

Caldwell, D. K., M. C. Caldwell and R. V. Walker. 1976. First records for Fraser's dolphin (*Lagenodelphis hosei*) in the Atlantic and the melon-headed whale (*Peponocephala electra*) in the western Atlantic. Cetology 25: 4.

Cañadas, A. 2006. Towards conservation of dolphins in the Alborán Sea. Ph.D. Dissertation, Departmento de Zoologia, Universidad Autónoma de Madrid.

Cañadas, A., R. Sagarminaga and T. S. Garcia. 2002. Cetacean distribution related with depth and slope in the Mediterranean waters off southern Spain. Deep Sea Research Part I Oceanographic Research Papers 49(11): 2053-2073.

Cañadas, A., G. Desportes, and D. Borchers. 2004. The estimation of the detection function and g(0) for short-beaked common dolphins (*Delphinus delphis*), using double-platform data collected during the NASS-95 Faroese survey. Journal of Cetacean Research and Management 6(2):191-198.

Cañadas, A. and P. S. Hammond. 2006. Model-based abundance estimates for bottlenose dolphins off southern Spain: Implications for conservation and management. Journal of Cetacean Research and Management 8(1):13-27.

Carretta, J. V., K.A. Fornery, M.S. Lowry, J. Barlow, J. Baker, D. Johnston, B. Hanson, M.M. Muto, D. Lynch, and L. Carswell. 2010. U.S. Pacific marine mammal stock assessments: 2009. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-434*.* NMFS Southwest Fisheries Science Center, La Jolla, CA.

Charif, R. A., D. K. Mellinger, K. J. Dunsmore and C. W. Clark. 2002. Estimated source levels of fin whale *(Balaenoptera physalus)* vocalizations: Adjustments for surface interference. Marine Mammal Science 18(1): 81-98.

Chaudry, F. A. 2006. A comparison of east Australian humpback whale migratory behaviour between the northern and southern migrations. ECS 2006*.* Gydnia, Poland.

Chittleborough, R. G. 1953. Aerial observations of the humpback whale (*Megaptera nodosa*). Aust. J. Mar. Freshw. Res. 4: 219-226.

Chu, K. C. 1988. Dive times and ventilation patterns of singing humpback whales (*Megaptera novaeangliae*). Canadian Journal of Zoology 66(6): 1322-1327.

Clapham, P. J. 1993. Social organization of humpback whales on a North Atlantic feeding ground. Symposium of the Zoological Society of London 66: 131-145.

Clark, C.W., P. Tyack, and W.T. Ellison. 1999 (Revised 2001). Overseas Environmental Impact Statement and Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar Technical Report 1: Low Frequency Sound Scientific Research Program Technical Report (Responses of Four Species of Whales to Sounds of SURTASS LFA Sonar Transmissions). For the Department of the Navy. February 1999 (Revised January 2001).

Coakes, A. K. and H. Whitehead. 2004. Social structure and mating system of sperm whales off northern Chile. Can J. Zool. 82(8): 1360-1369.

Crocker, M.J. 1997. Encyclopedia of acoustics. New York, New York: John Wiley & Sons, Inc.

Crocker, D. E., D. P. Costa, B. J. L. Boeuf, P. M. Webb and D. S. Houser. 2006. Impact of El Niño on the foraging behavior of female northern elephant seals. Marine Ecology Progress Series 309: 1-10.

Crocker, D. E., B. J. Le Boeuf, Y. Naito, T. Asaga and D. P. Costa. 1994. Swim speed and dive function in a female northern elephant seal. Pages 328-339 *in* B. J. Le Boeuf and R. M. Laws, eds. Elephant seals: Population ecology, behavior, and physiology. University of California Press: Berkeley, California,.

Croll, D. A., A. Acevedo-Gutierrez, B. R. Tershy and J. Urban-Ramirez. 2001a. The diving behavior of blue and fin whales: is dive duration shorter than expected based on oxygen stores? Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology 129(4): 797-809.

Croll, D.A., C.W. Clark, J. Calambokidis, W.T. Ellison, and B.R. Tershy. 2001b. Effect of anthropogenic low-frequency noise on the foraging ecology of *Balaenoptera* whales. Animal Conservation 4**:**13-27.

Croll, D. A., B. R. Tershy, R. P. Hewitt, D. A. Demer, P. C. Fiedler, S. E. Smith, W. Armstrong, J. M. Popp, T. Kiekhefer, V. R. Lopez, J. Urban and D. Gendron. 1998. An integrated approach to the foraging ecology of marine birds and mammals. Deep Sea Research II 45: 1353-1371.

Cruickshank, R. A. and S. G. Brown. 1981. Recent observations and some historical records of southern right-whale dolphins *Lissodelphis peronii*. Fish. Bull. S. Afr. 15: 109-121.

Cummings, W. C. 1985. Bryde's whale *Balaenoptera edeni* Anderson, 1878. Pages 137-154 *in* S. H. Ridgway and R. Harrison, eds. Handbook of marine mammals, Vol. 3: The sirenians and baleen whales. London: Academic Press.

Curren, K., N. Bose and J. Lien. 1994. Swimming kinematics of a harbor porpoise (*Phocoena phocoena*) and an Atlantic white-sided dolphin (*Lagenorhynchus acutus*). Marine Mammal Science 10(4): 485-492.

Dahlheim, M. E. and R. G. Towell. 1994. Occurrence and distribution of Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) in southeastern Alaska, with notes on an attack by killer whales (*Orcinus orca*). Marine Mammal Science 10(4): 458-464.

Davis, R. W., G. S. Fargion, N. May, T. D. Leming, M. Baumgartner, W. E. Evans, L. J. Hansen and K. Mullin. 1998. Physical habitat of cetaceans along the continental slope in the north-central and western Gulf of Mexico. Marine Mammal Science 14(3): 490-507.

Davis, R. W., N. Jaquet, D. Gendron, U. Markaida, G. Bazzino and W. Gilly. 2007. Diving behavior of sperm whales in relation to behavior of a major prey species, the jumbo squid, in the Gulf of California, Mexico. Marine Ecology Progress Series 333: 291-302.

Davis, R. W., G. A. J. Worthy, B. Würsig, S. K. Lynn and F. I. Townsend. 1996. Diving behavior and at-sea movements of an Atlantic spotted dolphin in the Gulf of Mexico. Marine Mammal Science 12(4): 569-581.

de Haro, J. C. and M. A. Iniguez. 1997. Ecology and behaviour of the Peale's dolphin, *Lagenorhynchus australis* (Peale, 1848), at Cabo Virgenes (52° 30'S, 68° 28'W), in Patagonia, Argentina. Report of the International Whaling Commission 47: 723-727.

Department of the Environment and Heritage. 2005. Humpback whale recovery plan 2005-2010. Wildlife Conservation Branch, Department of the Environment and Heritage, Canberra, Australia. http://www.deh.gov.au/biodiversity/threatened/recovery/list-common.html.

Doi, T. 1974. Further development of whale sighting theory. Pages 359-368 *in* W. E. Schevill, ed. The Whale Problem: A status report. Cambridge, MA: Harvard University Press.

Dolar, L. and W. Perrin. 2003. Dwarf sperm whale (*Kogia sima*) habitats in the Philippines. Pages 44 15th Biennial conference on the biology of marine mammals. Greensboro, NC.

Dolar, M. L. L., W. A. Walker, G. L. Kooyman and W. F. Perrin. 2003. Comparative feeding ecology of spinner dolphins (*Stenella longirostris*) and Fraser's dolphins (*Lagenodelphis hosei*) in the Sulu Sea. Marine Mammal Science 19(1): 1-19.

Dolar, M. L. L., W. F. Perrin, B. L. Taylor, G. L. Kooyman, and M. N. R. Alava. 2006. Abundance and distributional ecology of cetaceans in the central Philippines. Journal of Cetacean Research and Management 8(1):93-111.

Dolphin, W. F. 1987a. Dive behavior and estimated energy expenditure of foraging humpback whales in southeast Alaska. Canadian Journal of Zoology 65(2): 354-362.

Dolphin, W. F. 1987b. Ventilation and dive patterns of humpback whales, *Megaptera novaeangliae*, on their Alaskan feeding grounds. Canadian Journal of Zoology 65(1): 83-90.

Dolphin, W. F. 1988. Foraging dive patterns of humpback whales *Megaptera novaeangliae* in Southeast Alaska USA: A cost-benefit analysis. Canadian Journal of Zoology 66(11): 2432-2441.

DoN (Department of the Navy). 2001. Final Overseas Environmental Impact Statement and Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar. Washington, DC: Chief of Naval Operations.

DoN (U.S. Department of the Navy). 2007a. Final supplemental environmental impact statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar. Washington, D.C: Department of the Navy, Chief of Naval Operations.

DoN (Department of the Navy). 2007b. Navy OPAREA Density Estimates (NODE) for the Northeast OPAREAs: Boston, Narragansett Bay, and Atlantic City. Naval Facilities Engineering Command Atlantic, Norfolk, VA.

DoN (Department of the Navy). 2008a. Hawaii Range Complex Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). Pacific Missile Range Facility. Kekaha Kauai, HI. May 2008.

DoN (Department of the Navy). 2008b. Southern California (SOCAL) Range Complex Final Environmental Impact Statement/ Overseas Environmental Impact Statement. Naval Facilities Engineering Command Southwest. San Diego, CA. December 2008.

DoN (Department of the Navy). 2008c. Final Atlantic Fleet Active Sonar Training Environmental Impact Statement/ Overseas Environmental Impact Statement. United States Fleet Forces Command. Norfolk, VA. December 2008.

Edwards, E. F. 2006. Duration of unassisted swimming activity for spotted dolphin (*Stenella attenuata*) calves: implications for mother-calf separation during tuna purse-seine sets. Fishery Bulletin 104(1): 125-135.

Eguchi, T. and J. T. Harvey. 2005. Diving behavior of the Pacific harbor seal (*Phoca vitulina richardii*) in Monterey Bay, California. Marine Mammal Science 21(2): 283-295.

Ellison, W. T., R. M. Sonntag and C. W. Clark. 1987. Comparison of measured bowhead whale, *Balaena mysticetus*, migration parameters with results from the tracking algorithm. Reports of the International Whaling Commission 37: 309-311.

Evans, W. E. 1994. Common Dolphin, white bellied porpoise (*Delphnis delphis*, LInnaeus, 1758). Pages 191-224 *in* S. Ridgway and R. Harrison, eds. Handbook of Marine Mammals. Academic Press.

Ferguson, M. C., and J. Barlow. 2001. Spatial distribution and density of cetaceans in the eastern Pacific Ocean based on summer/fall research vessel surveys in 1986-96. NOAA Administrative Report LJ-01-04. NOAA, NMFS, SWFSC, La Jolla, CA.

Ferguson, M. C., and J. Barlow. 2003. Addendum: Spatial distribution and density of cetaceans in the eastern tropical Pacific Ocean based on summer/fall research vessel surveys in 1986-96. Administrative Report LJ-01-04 (Addendum). Southwest Fisheries Science Center, National

Feldkamp, S. D., R. L. Delong and G. A. Antonelis. 1989. Diving patterns of California sea lions, *Zalophus californianus*. Canadian Journal of Zoology 67(4): 872-883.

Feller, W. 1968. Introduction to probability theory and its application. Vol. 1. 3^{rd} ed. New York, New York: John Wiley & Sons.

Ferguson, M.C. and J. Barlow. 2001. Spatial distribution and density of cetaceans in the eastern tropical Pacific Ocean based on summer/fall research vessel surveys in 1986-1996. NMFS-SWFSC Administrative Report LJ-01-04:1-61.

Ferguson, M. C. and J. Barlow. 2003. Addendum: Spatial distribution and density of cetaceans in the eastern tropical Pacific Ocean based on summer/fall research vessel surveys in 1986-96. NMFS-SWFSC Administrative Report LJ-01-04 (Addendum):1-99.

Fertl, D., T. A. Jefferson , I. B. Moreno, A. N. Zerbini and K. D. Mullin. 2003. Distribution of the Clymene dolphin *Stenella clymene*. Mammal Review 33(3-4): 253-271.

Finley, K.J., G.W. Miller, R.A. Davis, and C.R. Greene. 1990 Reactions of belugas, *Delphinapterus leucas,* and narwhals, *Monodon monoceros,* to ice-breaking ships in the Canadian high arctic. Can. Bull. Fish. Aquat. Sci. 224:97-117.

Finneran, J.J., D.A. Carder, C.E. Schlundt, and R.L. Dear. 2010. Temporary threshold shift in a bottlenose dolphin (*Tursiops truncatus*) exposed to intermittent tones. Journal of the Acoustical Society 127(5):3267-3272.

Fish, F. E. and J. J. Rohr. 1999. Review of Dolphin Hydrodynamics and Swimming Performance. Spawar, 1999.

Forcada, J. and P. S. Hammond. 1998. Geographical variation in the abundance of striped and common dolphins of the western Mediterranean. Journal of Sea Research 39:313-325.

Forcada, J., G. Notarbartolo di Sciara, and F. Fabbri. 1995. Abundance of fin whales and striped dolphins in the Corso-Ligurian Basin. Mammalia 59(1):127-140.

Forcada, J., A. Aguilar, P. S. Hammond, X. Pastor, and R. Aguilar. 1996. Distribution and abundance of fin whales (*Balaenoptera physalus*) in the western Mediterranean Sea during the summer. Journal of Zoology, London 238:23-34.

Forcada, J., M. Gazo, A. Aguilar, J. Gonzalvo, and M. Fernandez-Contreras. 2004. Bottlenose dolphin abundance in the northwest Mediterranean: Addressing heterogeneity in distribution. Marine Ecology Progress Series 275:275-287.

Ford, J. K. B., G. A. Ellis, D. R. Matkin, K. C. Balcomb, D. Briggs and A. B. Morton. 2005. Killer whale attacks on minke whales: Prey capture and antipredator tactics. Marine Mammal Science 21(4): 603-618.

Frankel, A. S., C. W. Clark, L. M. Herman and C. M. Gabriele. 1995. Spatial Distribution, Habitat Utilization, and Social Interactions of Humpback Whales, *Megaptera novaeangliae*, off Hawai'i, determined using Acoustic and Visual Techniques. Canadian Journal of Zoology 73: 1134-1146.

Fristrup, K.M., L.T. Hatch, and C.W. Clark. 2003. Variation in humpback whale (*Megaptera novaeangliae*) song length in relation to low-frequency sound broadcasts. The Journal of the Acoustical Society of America 113(6):3411-3424.

Gabriele, C. M., J. M. Straley, L. M. Herman and R. J. Coleman. 1996. Fastest documented migration of a North Pacific humpback whale. Marine Mammal Science 12(3): 457-464.

Gannier, A. 1997. Estimation de l'abondance estivale du rorqual commun *Balaenoptera physalus* (Linné, 1758) dans le basin Liguro-Provençal (Méditerranée occidentale) (Abundance estimates of the fin whale *Balaenoptera physalus* (Linné, 1758) in the Ligurian-Provençal Basin (western Mediterranean)). Revue d'Ecologie: La Terre et la Vie 52:69-86.

Gannier, A. and K. L. West. 2005. Distribution of the Rough-Toothed Dolphin (*Steno bredanensis*) around the Windward Islands (French Polynesia). Pacific Science 59(1): 17-24.

Gentry, R. L. 2002. Northern fur seal *Callorhinus ursinus*. Pages 813-817 *in* W. F. Perrin, B. Wursig and J. G. M. Thewissen, eds. Encyclopedia of Marine Mammals. San Francisco, CA: Academic Press.

Gentry, R. L., G. L. Kooyman and M. E. Goebel. 1986. Feeding and Diving Behavior of Northern fur seals. Pages 61-78 *in* R. L. Gentry and G. L. Kooyman, eds. Fur seals: maternal strategies on land and at sea. Princeton: Princeton University Press.

Gerondeau, M., C. Barbraud, V. Ridoux, and C. Vincent. 2007. Abundance estimate and seasonal patterns of grey seal (*Halichoerus grypus*) occurrence in Brittany, France, as assessed by photo-identification and capture-mark-recapture. Journal of the Marine Biological Association of the United Kingdom 87(1):365-371.

Gerrodette, T. and J. Forcada. 2005. Non-recovery of two spotted and spinner dolphin populations in the eastern tropical Pacific Ocean. Marine Ecology Progress Series 291:1-21.

Gerrodette, T., G. Watters, W. Perryman, and L. Ballance. 2008. Estimates of 2006 dolphin abundance in the eastern tropical Pacific, with revised estimates from 1986-2003. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-422.

Gill, P. C. 2002. A blue whale (*Balaenoptera musculus*) feeding ground in a southern Australian coastal upwelling zone. Journal of Cetacean Research and Management 4(2): 179-184.

Gjertz, I., C. Lydersen and O. Wiig. 2001. Distribution and diving of harbor seals (*Phoca vitulina*) in Svalbard. Polar Biology 24(3): 209-214.

Goebel, M. E., J. L. Bengston, R. L. DeLong, R. L. Gentry and T. R. Loughlin. 1991. Diving patterns and foraging locations of female northern fur seals. Fishery Bulletin 89: 171-179.

Goldbogen, J., J. Calambokidis, R. E. Shadwick, E. M. Oleson, M. A. McDonald and J. A. Hildebrand. 2006. Kinematics of foraging dives and lunge-feeding in fin whales. Journal of Experimental Biology 209(7): 1231-1244.

Gómez de Segura, A., E. A. Crespo, S. N. Pedraza, P. S. Hammond, and J. A. Raga. 2006. Abundance of small cetaceans in waters of the central Spanish Mediterranean. Marine Biology 150:149-160.

Gunnlaugsson, T. and J. Sigurjónsson. 1990. NASS-87: Estimation of whale abundance based on observations made onboard Icelandic and Faroese survey vessels. Report of the International Whaling Commission 40:571-580.

Hammond, P. S., P. Berggren, H. Benke, D. L. Borchers, A. S. Collet, M. P. Heide-Jørgensen, S. L. Heimlich, A. R. Hiby, M. F. Leopold, and N. Øien. 2002. Abundance of harbour porpoise and other cetaceans in the North Sea and adjacent waters. Journal of Applied Ecology 39(2):361-376.

Hanson, M. B. and R. W. Baird. 1998. Dall's porpoise reactions to tagging attempts using a remotely-deployed suction-cup attached tag. Marine Technology Society Journal 32(2): 18-23.

Harris, C.M., ed. 1998. Handbook of acoustical measurements and noise control. Woodbury, New York: Acoustical Society of America.

Harzen, S. E. 2002. Use of an electronic theodolite in the study of movements of the bottlenose dolphin (*Tursiops truncatus*) in the Sado Estuary, Portugal. Aquatic Mammals 28(3): 251-260.

Hastings, K. K., K. J. Frost, M. A. Simpkins, G. W. Pendleton, U. G. Swain and R. J. Small. 2004. Regional differences in diving behavior of harbor seals in the Gulf of Alaska. Canadian Journal of Zoology 82(11): 1755-1773.

Heath, C. B. 2002. California, Galapagos, and Japanese Sea Lions. Pages 108-186 *in* W. F. Perrin, B. Wursig and J. G. M. Thewissen, eds. Encyclopedia of Marine Mammals. San Francisco, CA: Academic Press.

Heide-Jørgensen, M. P., D. Bloch, E. Stefansson, B. Mikkelsen, L. H. Ofstad and R. Dietz. 2002. Diving behaviour of long-finned pilot whales *Globicephala melas* around the Faroe Islands. Wildlife Biology 8(4): 307-313.

Heide-Jørgensen, M. P., M. J. Simon, and K. L. Laidre. 2007. Estimates of large whale abundance in Greenland waters from a ship-based survey in 2005. Journal of Cetacean Research and Management 9(2):95-104.

Heyning, J. E. and W. F. Perrin. 1994. Evidence for two species of common dolphins (genus *Delphinus*) from the eastern North Pacific. Contributions in Science 442: 1-35.

Higgins, L. V., D. P. Costa, A. C. Huntley and B. J. Le Boeuf. 1988. Behavioral and physiological measurements of the maternal investment in the Steller sea lion, *Eumetopias jubatus*. Marine Mammal Science 4(1): 44-58.

Hobson, R. P. and A. R. Martin. 1996. Behaviour and dive times of Arnoux's beaked whales, *Berardius arnuxii*, at narrow leads in fast ice. Canadian Journal of Zoology 74(2): 388-393.

Hohn, A., M. Scott, A. Westgate, J. Nicolas and B. Whitaker. 1995. Radiotracking of a rehabilitated pygmy sperm whale. Pages 55 Eleventh biennial conference on the biology of marine mammals. Orlando, FL.

Hooker, S. K. and R. W. Baird. 1999a. Deep-diving behaviour of the northern bottlenose whale, *Hyperoodon ampullatus* (Cetacea: Ziphiidae). Proceedings of the Royal Society of Biological Sciences: Series B. 266(1420): 671-676.

Hooker, S. K. and R. W. Baird. 1999b. Observations of Sowerby's beaked whales, *Mesoplodon bidens*, in the Gully, Nova Scotia. Canadian Field-Naturalist 113(2): 273-277.

Hui, C. A. 1987. Power and speed of swimming dolphins. Journal of Mammalogy 68(1): 126-132.

IWC (International Whaling Commission). 2009. Population estimates. <http:www.iwcoffice.org/conservation/estimate.htm>.

Jaquet, N., S. Dawson and E. Slooten. 2000. Seasonal distribution and diving behaviour of male sperm whales off Kaikoura: Foraging implications. Canadian Journal of Zoology 78(3): 407-419.

Jaquet, N. and D. Gendron. 2002. Distribution and relative abundance of sperm whales in relation to key environmental features, squid landings and the distribution of other cetacean species in the Gulf of California, Mexico. Marine Biology 141(3): 591-601.

Jaquet, N. and H. Whitehead. 1999. Movements, distribution and feeding success of sperm whales in the Pacific Ocean, over scales of days and tens of kilometers. Aquatic Mammals 25(1): 1-13.

Jefferson, T. A. 1987. A study of the behavior of Dall's porpoise (*Phocoenoides dalli*) in the Johnstone Strait, British Columbia. Canadian Journal of Zoology 65(3): 736-744.

Johnson, M., P. T. Madsen, W. M. X. Zimmer, N. Aguilar de Soto and P. L. Tyack. 2004. Beaked whales echolocate on prey. Proceedings of the Royal Society of London Series B-Biological Sciences 271: S383-S386.

Joyce, G., N. Øien, J. Calmabokidis and J. C. Cubbage. 1989. Surfacing rates of minke whales in Norwegian waters. Reports of the International Whaling Commission 39: 431-434.

Kaschner, K., J. S. Ready, E. Agbayani, J. Rius, K. Kesner-Reyes, P. D. Eastwood, A. B. South, S. O. Kullander, T. Rees, C. H. Close, R. Watson, D. Pauly and R. Froese (2008). AquaMaps: Predicted range maps for aquatic species. World wide web electronic publication, www.aquamaps.org, Version 10/2008.

Kastelein, R. A. and N. M. Gerrits. 1991. Swimming, diving, and respiration patterns of a Northern bottlenose whale (*Hyperoodon ampullatus*, Forster, 1770). Aquatic Mammals 17(1): 20-30.

Kasuya, T. 1986. Distribution and behavior of Baird's beaked whales off the Pacific coast of Japan. Scientific Report of the Whales Research Institute 37:61-83.

Kasuya, T., and T. Miyashita. 1988. Distribution of sperm whale stocks in the North Pacific. Scientific Report of the Whales Research Institute 39:31-75.

Kato, H., and T. Miyashita. 1998. Current status of North Pacific sperm whales and its preliminary abundance estimates. Report submitted to the International Whaling Commission (SC/50/CAWS/52). 6 pp.

Kenney, R. D. and H. E. Winn. 1986. Cetacean high-use habitats of the northeast United States continental shelf. Fishery Bulletin 84(2): 345- 357.

Ketten, D.R. 1997. Structure and function in whale ears. Bioacoustics 8:103-135.

Knastner, A., ed.. 1998. Mitigation guidelines for high-energy seismic surveys off southern California. HESS workshop report. Mediation Institute, Pepperdine University, Malibu, California.

Kooyman, G. L. and H. T. Andersen. 1969. Deep diving. Pages 65-94 *in* H. T. Andersen, ed. Biology of marine mammals. Academic Press.

Kooyman, G. L. and F. Trillmich. 1986. Diving Behavior of Galapagos fur seals. Pages 186-195 *in* R. L. Gentry and G. L. Kooyman, eds. Fur seals: maternal strategies on land and at sea. Princeton: Princeton University Press.

Kopelman, A. H. and S. S. Sadove. 1995. Ventilatory rate differences between surface-feeding and non-surface-feeding fin whales (*Balaenoptera physalus*) in the waters off eastern Long Island, New York, U.S.A., 1981-1987. Marine Mammal Science 11(2): 200-208.

Kriete, B. 2002. Bioenergetic changes from 1986 to 2001 in the southern resident killer whale population, *Orcinus orca*. Orca Relief Citizens' Alliance.

Kryter, K.D. 1985. The effects of noise on man, 2nd edition. Orlando, FLorida: Academy Press. 688 pp.

Kryter, K.D., W.D. Ward, J.D. Miller, and D.H. Eldredge. 1966. Hazardous exposure to intermittent and steady-state noise. Journal of the Acoustical Society of America 39(3):451-464.

Lagerquist, B. A., K. M. Stafford and B. R. Mate. 2000. Dive characteristics of satellite-monitored blue whales (*Balaenoptera musculus*) off the central California coast. Marine Mammal Science 16(2): 375-391.

Laurie, A. H. 1933. Some aspects of respiration in fin and blue whales. Discovery Reports 7: 365-406.

Law, T. C. and R. W. Blake. 1994. Swimming behaviors and speeds of wild Dall's porpoises (*Phocoenoides dalli*). Marine Mammal Science 10(2): 208-213.

Le Boeuf, B. J. 1994. Variation in the Diving Pattern of Northern Elephant Seals with Age, Mass, Sex, and Reproductive Condition. Pages 237-252 *in* B. J. Le Boeuf and R. M. Laws, eds. Elephant Seals: Population Ecology, Behavior, and Physiology. Berkeley, CA: University of California Press.

Le Boeuf, B. J., D. P. Costa, A. C. Huntley and S. D. Feldkamp. 1988. Continuous, deep diving in female northern elephant seals, *Mirounga angustirostris*. Canadian Journal of Zoology 66: 446-458.

Le Boeuf, B. J., Y. Naito, A. C. Huntley and T. Asaga. 1989. Prolonged, continuous, deep diving by northern elephant seals. Canadian Journal of Zoology 67: 2514-2519.

Leatherwood, S. and D. K. Ljungblad. 1979. Nighttime swimming and diving behavior of a radio -tagged spotted dolphin *Stenella attenuata*. Cetology 34: 1-6.

Leatherwood, S., W. F. Perrin, V. L. Kirby, C. L. Hubbs and M. Dahlheim. 1980. Distribution and Movements of Risso's Dolphin *Grampus griseus* in the Eastern North Pacific. Fishery Bulletin Washington D C 77(4): 951-964.

Leatherwood, S. and W. A. Walker. 1979. The northern right whale dolphin *Lissodelphis borealis* Peale in the eastern north pacific. Pages 85-141 Behavior of Marine animals: Current perspectives in research. Plenum: H. E. Winn, B. L. Olba.

Leibiger, G. A. 1978. The acoustic propagation model RAYMODE: Theory and numerical treatment. U.S. Naval Underwater Systems Center (NUSC), New London, Connecticut.

Lesage, V., M. O. Hammill and K. M. Kovacs. 1999. Functional classification of harbor seal (*Phoca vitulina*) dives using depth profiles, swimming velocity, and an index of foraging success. Canadian Journal of Zoology 77(1): 74-87.

Ligon, A. D. and R. W. Baird. 2001. Diving behaviour of false killer whales off Maui and Lana'i, Hawai'i. 14th Biennial Conference on the Biology of Marine Mammals. Vancouver.

Lockyer, C. 1976. Body Weights of Some Species of Large Whales. J. Cons. int. Explor. Mer. 36(3): 259-273.

Lockyer, C. 1997. Diving behaviour of the sperm whale in relation to feeding. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique Biologie 67(SUPPL): 47-52.

Lockyer, C. and R. Morris. 1987. Observations on diving behavior and swimming speeds in a wild juvenile *Tursiops truncatus*. Aquatic Mammals 13(1): 31-35.

Lockyer, C. and R. J. Morris. 1986. The history and behavior of a wild, sociable bottlenose dolphin (*Tursiops truncatus*) off the north coast of Cornwall (England, UK). Aquatic Mammals 12(1): 3-16.

Loughlin, T. R. 1982. Observations of *Mesoplodon stejnegeri* in the central Aleutian Islands, Alaska. Journal of Mammalogy 63(3): 697-700.

MacLeod, C. D. and A. F. Zuur. 2005. Habitat utilization by Blainville's beaked whales off Great Abaco, northern Bahamas, in relation to seabed topography. Marine Biology 147(1): 1-11.

MacLeod, K., M. P. Simmonds, and E. Murray. 2006. Abundance of fin (*Balaenoptera physalus*) and sei whales (*B. borealis*) amid oil exploration and development off northwest Scotland. Journal of Cetacean Research and Management 8(3):247-254.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior, Phase I. BBN Report 563. Report from Bolt, Beranek, & Newman, Inc., Cambridge, Massachusetts, for U.S. Minerals Management Service, Anchorage, Alaska.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior, Phase II: January 1984 migration. BBN Report 586. Report from Bolt, Beranek, & Newman, Inc., Cambridge, Massachusetts, for U.S. Minerals Management Service, Anchorage, Alaska.

Markowitz, T. M. 2004. Social organization of the New Zealand dusky dolphin. Ph.D. dissertation, Texas A&M University, Galveston, TX. 278 pp.

Masaki, Y. 1977. The separation of the stock units of sei whales in the North Pacific. Report of the International Whaling Commission Special Issue 1:71-79.

Mate, B. R., Gisiner, R., and Mobley, J. 1998. Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. Canadian Journal of Zoology 76: 863-868.

Mate, B.R. and J.T. Harvey. 1984. Ocean Movements of Radio--tagged Gray Whales. Pages 577-589 The Gray Whale. London: Academic Press.

Mate, B. R., K. M. Stafford, R. Nawojchik and J. L. Dunn. 1994a. Movements and dive behavior of a satellite-monitored Atlantic white-sided dolphin (*Lagenorhynchus acutus*) in the Gulf of Maine. Marine Mammal Science 10(1):116-121.

Mate, B.R., K.M. Stafford and D.K. Ljungblad. 1994b. A change in sperm whale distribution correlated to seismic surveys in the Gulf of Mexico. Journal of the Acoustical Society of America 96(5, pt. 2):3268-3269.

Mate, B. R., K. A. Rossbach, S. L. Nieukirk, R. S. Wells, A. B. Irvine, M. D. Scott and A. J. Read. 1995. Satellite-monitored movements and dive behaviour of a bottlenose dolphin (*Tursiops truncatus*) in Tampa Bay, Florida. Marine Mammal Science 11(4):452-463.

Mate, B. R., S. L. Nieukirk and S. D. Kraus. 1997. Satellite-monitored movements of the northern right whale. Journal of Wildlife Management 61(4):1393-1405.

Mate, B. R., B. A. Lagerquist and J. Calambokidis. 1999. Movements of North Pacific blue whales during the feeding season off southern California and their southern fall migration. Marine Mammal Science 15(4): 1246-1257.

Mate, B. R., B. A. Lagerquist, M. Winsor, J. Geraci and J. H. Prescott. 2005. Movements and dive habits of a satellite-monitored longfinned pilot whale (*Globicephala melas*) in the northwest Atlantic. Marine Mammal Science 21(1): 136-144.

May-Collado, L., T. Gerrodette, J. Calambokidis, K. Rasmussen and I. Sereg. 2005. Patterns of cetacean sighting distribution in the Pacific Exclusive Economic Zone of Costa Rica based on data collected from 1979-2001. Revista De Biologia Tropical 53(1-2): 249-263.

May-Collado, L. and A. M. Ramirez. 2005. Occurrence and behavioral patterns of the spotted coastal dolphin *Stenella attenuata* (Cetacea : Delphinidae) in the Gulf of Papagayo, Costa Rica. Revista De Biologia Tropical 53(1-2): 265-276.

Melin, S. R. and R. L. DeLong. 1999. Observations of a Guadalupe fur seal (*Arctocephalus townsendi*) female and pup at San Miguel Island, California. Marine Mammal Science 15(3): 885-888.

Merrick, R. L. and T. R. Loughlin. 1997. Foraging behavior of adult female and young-of-the-year Steller sea lions in Alaskan waters. Canadian Journal of Zoology 75: 776-786.

Merrick, R. L., T. R. Loughlin, G. A. Antonelis and R. Hill. 1994. Use of satellite-linked telemetry to study Steller sea lion and northern fur seal foraging. Polar Research 13(1): 105-114.

Miller, P.J.O., N. Biassoni, A. Samuels and P.L. Tyack. 2000. Whales songs lengthen in response to sonar. Nature 405: 903.

Miller, P. J. O., M. P. Johnson, P. L. Tyack and E. A. Terray. 2004. Swimming gaits, passive drag and buoyancy of diving sperm whales *Physeter macrocephalus*. Journal of Experimental Biology 207(11): 1953-1967.

Minton, G., T. Collins, C. Pomilla, K. P. Findlay, H. Rosenbaum, R. Baldwin, and R. L. Brownell, Jr. 2008. *Megaptera novaeangliae* (Arabian Sea subpopulation). IUCN Red List of Threatened Species. Version 2009.1. http://www.iucnredlist.org.

Minton, G., T. Collins, K. P. Findlay, P. J. Ersts, H. Rosenbaum, P. Berggren, and R. Baldwin. In Press. Seasonal distribution, abundance, habitat use and population identity of humpback whales in Oman. Journal of Cetacean Research and Management.

Miyashita, T. 1986. Population estimates of dolphins using research vessels data. Pages 202-213 in T. Tamura, S. Ohsumi, and S. Arai (eds.). Report of the investigation in search of resolution of the dolphin-fishery conflict in the Iki Island area. The Investigating Committee, Tokyo.

Miyashita, T. 1993. Abundance of dolphin stocks in the western North Pacific taken by the Japanese drive fishery. Reports of the International Whaling Commission 43**:** 417-437.

Miyazaki, N. and W. F. Perrin. 1994. Rough-toothed dolphin *Steno bredanensis* (Lesson, 1828). Pages 1-21 *in* S. H. Ridgway and R. Harrison, eds. Handbook of marine mammals, Volume 5: The first book of dolphins. London: Academic Press.

Miyazaki, N. and S. Wada. 1978. Frasers Dolphin *Lagenodelphis hosei* in the Western North Pacific. Scientific Reports of the Whales Research Institute Tokyo (30): 231-244.

Mobley, J. R., jr and L. M. Herman. 1985. Transience of social affiliations among humpback whales (*Megaptera novaeangliae*) on the Hawaiian wintering grounds. Canadian Journal of Zoology 63: 762-772.

Mobley, J. R., Jr., S. S. Spitz, K. A. Forney, R. Grotefendt and P. H. Forestell. 2000. Distribution and abundance of odontocete species in Hawaiian waters: Preliminary results of 1993-98 aerial surveys. NMFS-SWFSC Administrative Report LJ-00-14C:1-26.

Morris, C. and U. Tscherter. 2006. Site fidelity of individual minke whales (*Balaenoptera acutorostrata*) in the St. Lawrence estuary. ECS 2006. Gydnia, Poland.

Mullin, K. D. and G. L. Fulling. 2003. Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fishery Bulletin 101(3):603-613.

Mullin, K. D., W. Hoggard and L. J. Hansen. 2004. Abundance and seasonal occurence of cetaceans in outer continental shelf and slope waters of the North-central and Northwestern Gulf of Mexico. Gulf of Mexico Science 1: 62-73.

NAMMCO (North Atlantic Marine Mammal Commission). 2006. Report of the Fourteenth Meeting of the NAMMCO Scientific Committee. NAMMCO, Reykjavik, Iceland.

NARWC (North Atlantic Right Whale Consortium). 2009. North Atlantic right whale report card for 1 November 2007 to 30 April 2009. International Whaling Commission's Scientific Committee Report #SC/61/BRG11.National Marine Fisheries Service (NMFS). 2008. Office of Protected Resources Letter to Chief of Naval Operations (N45). Jan 31, 2008.

Nawojchik, R., D. J. St Aubin and A. Johnson. 2003. Movements and dive behavior of two stranded, rehabilitated long-finned pilot whales (*Globicephala melas*) in the northwest Atlantic. Marine Mammal Science 19(1): 232-239.

Nerini, M. 1984. A Review of Gray Whale Feeding Ecology. Pages 423-448 *in* M. Jones, Swartz, S., and Leatherwood, S., ed. The Gray Whale. Orlando, FL: Academic Press, Inc.

Neufeldt, V. (ed). 1997. Webster's New World College Dictionary, 3rd Edition. Simon & Schuster, Inc., NY, NY.

Neves, H. C. 1998. Preliminary findings on the feeding behaviour and general ecology strategy of the mediterranean monk seal *Monachus monachus* - (Pinnipedia: monachinae) on the Desertas islands. Boletim do Museu Municipal do Funchal 5(SUPPL. 5 PART A): 263-271.

Nishiwaki, M. 1972. General biology. Pages 3-204 *in* S. H. Ridgway, ed. Mammals of the sea: Biology and medicine. Charles C. Thomas.

Norris, K. S. and T. P. Dohl. 1980. Behavior of the Hawaiian Spinner Dolphin, *Stenella longirostris*. Fishery Bulletin 77(4): 821-849.

Norris, K. S. and J. H. Prescott. 1961. Observations on Pacific cetaceans of Californian and Mexican waters. University of California Publications in Zoology 63: 291-402.

Nøttestad, L., A. Ferno and B. E. Axelsen. 2002. Digging in the deep: Killer whales' advanced hunting tactic. Polar Biology 25(12): 939-941.

Nowacek, D. P., M. P. Johnson and P. L. Tyack. 2004. North Atlantic right whales (*Eubalaena glacialis*) ignore ships but respond to alerting stimuli. Proceedings of the Royal Society of London Series B-Biological Sciences 271(1536): 227-231.

Nowacek, D. P., L. H. Thorne, D. W. Johnston and P. L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 37(2): 81-115.

NRC (National Research Council). 1994. Low-frequency sound and marine mammals: Current knowledge and research needs. Washington, D.C.: National Academy Press.

NRC (National Research Council). 2000. Marine mammals and low-frequency sound progress since 1994. Committee on low-frequency sound and marine mammals. Report to U.S. Office of Naval Research Contract No. N00014-92-J-1560/R. Washington, D.C: National Academy Press.

OAML. 2000. Database description for the General Digital Enviornmental Model - Variable Resolution (GDEM-V) Version 2.5.

Øien, N. I. 2008. Distribution and abundance of large whales in Norwegian and adjacent waters based on ship surveys 1995-2001. NAMMCO Scientific Publications 7:31-47.

Øien, N., L. Folkow and C. Lydersen. 1990. Dive Time Experiments On Minke Whales in Norwegian Waters During the 1988 Season. Reports of the International Whaling Commission 40: 337-341.

Olavarria, C., L. A. Aguayo and R. Bernal. 2001. Distribution of Risso's dolphin (*Grampus griseus*, Cuvier 1812) in Chilean waters. Revista de Biologia Marina y Oceanografia 36(1): 111-116.

Olsen, E. and J. C. Holst. 2001. A note on common minke whale (*Balaenoptera acutorostrata*) diets in the Norwegian Sea and the North Sea. Journal of Cetacean Research and Management 3(2): 179-183.

Ohsumi, S. 1977. Bryde's whales in the pelagic whaling ground of the North Pacific. Report of the International Whaling Commission Special Issue 1:140-149

Otani, S. 2000. Diving behavior and swimming speed of a free-ranging harbor porpoise, *Phocoena phocoena*. Marine Mammal Science 16(4): 811-814.

Panigada, S., G. Nortarbartolo di Sciara, M. Panigada, S. Airoldi, J. Borsani and M. Jahoda. 2005. Fin whales (*Balaenoptera physalus*) summering in the Ligurian Sea: distribution, encounter rate, mean group size and relation to physiographic variables. The Journal of Cetacean Research and Management 7(2): 137-145.

Panigada, S., M. Zanardelli, S. Canese and M. Jahoda. 1999. How Deep Can Baleen Whales Dive? Marine Ecology Progress Series 187: 309-311.

Papastavrou, V., S. C. Smith and H. Whitehead. 1989. Diving behavior of the sperm whale *Physeter macrocephalus* off the Galapagos Islands, Ecuador. Canadian Journal of Zoology 67(4): 839-846.

Parks, S. E. and P. L. Tyack. 2005. Sound production by North Atlantic right whales (*Eubalaena glacialis*) in surface active groups. Journal of the Acoustical Society of America 117(5): 3297-3306.

Parrish, F. A., K. Abernathy, G. J. Marshall and B. M. Buhleier. 2002. Hawaiian monk seals (*Monachus schauinslandi*) foraging in deep-water coral beds. Marine Mammal Science 18(1): 244-258.

Parrish, F. A., M. P. Craig, T. J. Ragen, G. J. Marshall and B. M. Buhleier. 2000. Identifying diurnal foraging habitat of endangered Hawaiian monk seals using a seal-mounted video camera. Marine Mammal Science 16(2): 392-412.

Pastene, L.A. and M. Goto. 1998. An estimate of the mixing proportion of ‘J’ and ‘O’ stocks minke whales in subarea 11 based on mitochondrial DNA haplotype data. Report of the International Whaling Commission 48: 471-474.

Perryman, W. L., M. A. Donahue, J. L. Laake and T. E. Martin. 1999. Diel variation in migration rates of eastern Pacific gray whales measured with thermal imaging sensors. Marine Mammal Science 15(2): 426-445.

Ponganis, P. J., R. L. Gentry, E. P. Ponganis and K. V. Ponganis. 1992. Analysis of swim velocities during deep and shallow dives of two northern fur seals *Callorhinus ursinus*. Marine Mammal Science 8(1): 69-75.

Ramirez, N., D. Schulte and J. Kennedy. 2006. Finback whale (*Balaenoptera physalus*) behavior on Jeffreys Ledge in the Gulf Of Maine. ECS 2006. Gydnia, Poland.

Raum-Suryan, K. L., K. W. Pitcher, D. G. Calkins, J. L. Sease and T. R. Loughlin. 2002. Dispersal, rookery fidelity, and metapopulation structure of Steller sea lions (*Eumetopias jubatus*) in an increasing and a decreasing population in Alaska. Marine Mammal Science 18(3): 746-764.

Raum-Suryan, K. L., M. J. Rehberg, G. W. Pendleton, K. W. Pitcher and T. S. Gelatt. 2004. Development of dispersal, movement patterns, and haul-out use by pup and juvenile Steller sea lions (*Eumetopias jubatus*) in Alaska. Marine Mammal Science 20(4): 823-850.

Ream, R. R., J. T. Sterling and T. R. Loughlin. 2005. Oceanographic features related to northern fur seal migratory movements. Deep Sea Research Part II: Topical Studies in Oceanography 52(5-6): 823-843.

Reeves, R. R., B. S. Stewart, J. Clapham Phillip and J. A. Powell. 2002. Guide to Marine Mammals of the World. New York: Knopf.

Reilly, S. B. and V. G. Thayer. 1990. Blue Whale *Balaenoptera musculus* Distribution in the Eastern Tropical Pacific. Marine Mammal Science 6(4): 265-277.

Rice, D. W. and A. A. Wolman. 1971. The life history and ecology of the gray whale (*Eschrichtius robustus*). Am. Soc. Mammalog. Spec. Publ. 3.

Richardson, W.J., ed. 1997. Northstar marine mammal monitoring program, 1996: marine mammals and acoustical monitoring of a seismic program in the Alaskan Beaufort Sea. Final Report, LGL Report TA2121-2. Prepared for BP Exploration (Alaska) Inc., and Greeneridge Sciences, Inc. Anchorage: LGL Ltd.

Richardson, W.J., ed. 1998. Marine mammals and acoustical monitoring of BPXA's seismic program in the Alaskan Beaufort Sea, 1997. Final Report, LGL Report TA2150-3. Prepared for BP Exploration (Alaska), Inc. and National Marine fisheries Service by LGL, Ltd. and Greeneridge Sciences, Inc. Anchorage: LGL, Ltd.

Richardson, W.J., K.J. Finley, G.W. Miller, R.A. Davis, and W.A. Koski. 1995a. Feeding, social and migration behavior of bowhead whales, *Balaena mysticetus*, in Baffin Bay versus the Beaufort Sea regions with different amounts of human behavior. Marine Mammal Science 11:1-45.

Richardson, W. J., C. R. Greene, C. I. Malme and D. H. Thomson. 1995b. Marine mammals and noise. San Diego: Academic Press.

Ridoux, V., C. Guinet, C. Liret, P. Creton, R. Steenstrup and G. Beauplet. 1997. A video sonar as a new tool to study marine mammals in the wild: measurements of dolphin swimming speed. Marine Mammal Science 13(2): 196-206.

Ries, E. H., I. M. Traut, P. Paffen and P. W. Goedhart. 1997. Diving patterns of harbour seals (*Phoca vitulina*) in the Wadden Sea, the Netherlands and Germany, as indicated by VHF telemetry. Canadian Journal of Zoology 75(12): 2063-2068.

Ritter, F. 2002. Behavioural observations of rough-toothed dolphins (*Steno bredanensis*) off La Gomera, Canary Islands (1995-2000), with special reference to their interactions with humans. Aquatic Mammals 28(1): 46-59.

Ritter, F. and B. Brederlau. 1999. Behavioural observations of dense beaked whales (*Mesoplodon densirostris*) off La Gomera, Canary Islands (1995-1997). Aquatic Mammals 25(2): 55-61.

Robison, B. H. and J. E. Craddock. 1983. Mesopelagic Fishes Eaten by Frasers Dolphin *Lagenodelphis hosei*. Fishery Bulletin Washington D C 81(2): 283-290.

Rohr, J. J., F. E. Fish and J. W. Gilpatrick. 2002. Maximum swim speeds of captive and free-ranging delphinids: Critical analysis of extraordinary performance. Marine Mammal Science 18(1): 1-19.

Rose, B. and A. I. L. Payne. 1991. Occurrence and behavior of the southern right whale dolphin *Lissodelphis peronii* off namibia. Mar Mammal Sci 7(1): 25-34.

Rosenbaum, H. C. C. Pomilla, M. Mendez, M. S. Leslie, P. B. Best, K. P. Findlay, G. Minton, P. J. Ersts, T. Collins, M. H. Engel, S. L. Bonatto, D. P. G. H. Kotze, M. Meyer, J. Barendse, M. Thornton, Y. Razafindrakoto, S. Ngouessono, M. Velly, and J. Kiszka. 2009. Population structure of humpback whales from their breeding grounds in the South Atlantic and Indian oceans. PLoS ONE 4(10):e7318. doi:10.1371/journal.pone.0007318.

Rugh, D. J. 1984. Census of gray whales at Unimak Pass, Alaska: November-December 1977-1979. Pages 225-248 *in* M. L. Jones, S. L. Swartz and S. Leatherwood, eds. The gray whale, *Eschrichtius robustus.* Academic Press.

Schilling, M. R., I. Seipt, M. T. Weinrich, A. E. Kuhlberg and P. J. Clapham. 1992. Behavior of individually-identified sei whales *Balaenoptera borealis* during an episodic influx into the southern gulf of maine in 1986. U S Natl Mar Fish Serv Fish Bull 90(4): 749-755.

Scott, M. D., A. A. Hohn, A. J. Westgate, J. R. Nicolas, B. R. Whitaker and W. B. Campbell. 2001. A note on the release and tracking of a rehabilitated pygmy sperm whale (*Kogia breviceps*). Journal of Cetacean Research and Management 3(1): 87-94.

Scott, T. M. and S. S. Sadove. 1997. Sperm Whale, *Physeter macrocephalus*, sightings in the shallow shelf waters off Long Island, New York. Marine Mammal Science 13(2): 317-320.

Selzer, L. A. and P. M. Payne. 1988. The distribution of white-sided (*Lagenorhynchus acutus*) and common dolphins (*Delphinus delphis*) vs. environmental features of the continental shelf of the northeastern United States. Marine Mammal Science 4(2): 141-153.

Shane, S. H. 1995. Behavior patterns of pilot whales and Risso's dolphins off Santa Catalina Island, California. Aquatic Mammals 21(3): 195-197.

Silber, G. K., M. W. Newcomer and H. M. Pérez-Cortés. 1990. Killer Whales (*Ornicus orca*) attack and kill a Bryde's whale (*Balaenoptera edeni*). Canadian Journal of Zoology 68: 1603-1606.

Silber, G. K., M. W. Newcomer, P. C. Silber, H. Pérez-Cortés M and G. M. Ellis. 1994. Cetaceans of the northern Gulf of California: distribution, occurrence, and relative abundance. Marine Mammal Science 10(3): 283-298.

Skaug, H. J., N. Øien, T. Schweder, and G. Bothun. 2004. Abundance of minke whales (*Balaenoptera acutorostrata*) in the Northeast Atlantic: variability in time and space. Canadian Journal of Fisheries and Aquatic Sciences 61(6):870-886.

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene, Jr., D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas and P. L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations Aquatic Mammals 33(4): 411-521.

Stern, S. J. 1992. Surfacing rates and surfacing patterns of minke whales (*Balaenoptera acutorostrata*) off central California, and the probability of a whale surfacing within visual range. Report of the International Whaling Commission 42: 379-385.

Stevick, P. T., J. Allen, P. J. Clapham, N. Friday, S. K. Katona, F. Larsen, J. Lien, D. K. Mattila, P. J. Palsbøll, J. Sigurjónsson, T. D. Smith, N. Øien, and P. S. Hammond. 2003. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. Marine Ecology Progress Series 258:263-273.

Stewart, B. S. and R. L. DeLong. 1995. Double migrations of the northern elephant seal, *Mirounga angustirostris*. Journal of Mammalogy 76(1): 196-205.

Stewart, B. S. and P. K. Yochem. 1999. Community ecology of California Channel Islands pinnipeds. Pages 413-420 *in* D. R. Browne, ed. Fifth California Islands Symposium. Santa Barbara Museum of Natural History, Santa Barbara, California.

Stockin, K. A., R. S. Fairbairns, E. C. M. Parsons and D. W. Sims. 2001. Effects of diel and seasonal cycles on the dive duration of the minke whale (*Balaenoptera acutorostrata*). Journal of the Marine Biological Association of the United Kingdom 81(1): 189-190.

Stone, G. S., S. K. Katona, M. Mainwaring, J. M. Allen and H. D. Corbett. 1992. Respiration and surfacing rates of fin whales (*Balaenoptera physalus*) observed from a lighthouse tower. Reports of the International Whaling Commission 42: 739-745.

Teloni, V., J. P. Mark, M. J. O. Patrick and M. T. Peter. 2008. Shallow food for deep divers: Dynamic foraging behavior of male sperm whales in a high latitude habitat. Journal of Experimental Marine Biology and Ecology 354(1): 119-131.

Tillman, M. F. 1977. Estimates of population size for the North Pacific sei whale. Report of the International Whaling Commission Special Issue 1:98-106.

Trillmich, F. 1986. Attendance behavior of Galapagos fur seals. Pages 168-185 *in* R. L. Gentry and G. L. Kooyman, eds. Fur Seals: Maternal Strategies on Land and at Sea. Princeton, NJ: Princeton University Press.

Tyack, P.L. and C. W. Clark. 1998. Quicklook-Playback of low frequency sound to gray whales migrating past the central California coast in January 1998. 55 pp.

Tynan, C. T., D. G. Ainley, J. A. Barth, T. J. Cowles, S. D. Pierce and L. B. Spear. 2005. Cetacean distributions relative to ocean processes in the northern California Current System. Deep-Sea Research II 52(1-2): 145-167.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Geophysical Data Center. 2006. 2-minute Gridded Global Relief Data (ETOPO2v2) http://www.ngdc.noaa.gov/mgg/fliers/06mgg01.html

Urick, R.J. 1983. Principles of underwater sound, 3rd ed. New York, New York: McGraw-Hill.

Wade, P. R. and T. Gerrodette. 1993. Estimates of cetacean abundance and distribution in the eastern tropical Pacific. Report of the International Whaling Commission 43:477-493.

Wahlberg, M. 2002. The acoustic behaviour of diving sperm whales observed with a hydrophone array. Journal of Experimental Marine Biology and Ecology 281(1-2): 53-62.

Ward, W. D. 1997. Effects of high intensity sound. Pages 1497-1507 in M.J. Crocker, ed. Encyclopedia of Acoustics. New York, New York: J. Wiley and Sons, Inc.

Ward, W.D. (ed.). 1968. Proposed damage-risk criterion for impulsed noise (gunfire). Committee on Hearing, Bioacoustics and Biomechanics. National Research Council, National Academy of Science, Washington, D.C.

Waring, G. T., L. Nottestad, E. Olsen, H. Skov, and G. Vikingsson. 2008. Distribution and density estimates of cetaceans along the mid-Atlantic Ridge during summer 2004. Journal of Cetacean Research and Management 10(2):137-146.

Waring, G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel, editors. 2009. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2009. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NE-213. Woods Hole, MA. 528 p.

Watkins, W. A. 1981. Activities and Underwater Sounds of Fin Whales. The scientific reports of the whales research institute (33): 83-117.

Watkins, W.A., and W.E. Schevill. 1975. Sperm whales (*Physeter macrocephalus*) react to pingers. Deep-Sea Research 22:123-129.

Watkins, W.A., K.E. Moore, P. Tyack. 1985. Sperm whale acoustic behaviors in the southeast Caribbean. Cetology 49:1-15.

Watkins, W. A., P. Tyack, K. E. Moore and G. N. di Sciara. 1987. *Steno bredaneisis* in the Mediterranean Sea. Marine Mammal Science 3(1): 78-82.

Watkins, W. A., M. A. Daher, K. Fristrup and G. N. d. Sciara. 1994. Fishing and Acoustic Behavior of Fraser's Dolphin (*Lagenodelphis hosei*) near Dominica, Southeast Caribbean. Caribbean Journal of Science 30(1-2): 76-82.

Watkins, W. A., M. A. Daher, N. A. DiMarzio, A. Samuels, D. Wartzok, K. M. Fristrup, D. P. Gannon, P. W. Howey, R. R. Maiefski and T. R. Spradlin. 1999. Sperm whale surface activity from tracking by radio and satellite tags. Marine Mammal Science 15(4): 1158-1180.

Watkins, W. A., M. A. Daher, N. A. DiMarzio, A. Samuels, D. Wartzok, K. M. Fristrup, P. W. Howey and R. R. Maiefski. 2002. Sperm whale dives tracked by radio tag telemetry. Marine Mammal Science 18(1): 55-68.

Weinrich, M. T., C. R. Belt and D. Morin. 2001. Behavior and ecology of the Atlantic white-sided dolphin (*Lagenorhynchus acutus*) in coastal New England waters. Marine Mammal Science 17(2): 231-248.

Weir, C. R. 2000. Sightings of beaked whales species (Cetacea: Ziphiidae) in the waters to the north and west of Scotland and the Faroe Islands. European Research on Cetaceans 14: 239-243.

Weise, M. J., D. P. Costa and R. M. Kudela. 2006. Movement and diving behavior of male California sea lion (*Zalophus californianus*) during anomalous oceanographic conditions of 2005 compared to those of 2004. Geophysical Research Letters 33(22): 1-6.

Weller, D. W., S. H. Reeve, A. M. Burdin, B. Würsig and R. L. Brownell, Jr. 2002. A note on the spatial distribution of western gray whales (*Eschrichtius robustus*) off Sakhalin Island, Russia in 1998. Journal of Cetacean Research and Management 4(1): 13-17.

Wells, R. S., H. L. Rhinehart, P. Cunningham, J. Whaley, M. Baran, C. Koberna and C. D. P. 1999. Long distance offshore movements of bottlenose dolphins. Marine Mammal Science 15(4): 1098-1114.

Westgate, A. J., A. J. Read, P. Berggren, H. N. Koopman and D. E. Gaskin. 1995. Diving behaviour of harbour porpoises, *Phocoena phocoena*. Canadian Journal of Fisheries and Aquatic Sciences 52(5): 1064-1073.

Whitehead, H., S. Brennan and D. Grover. 1992. Distribution and Behavior of Male Sperm Whales on the Scotian Shelf, Canada. Canadian Journal of Zoology 70(5): 912-918.

Whitehead, H., S. C. Smith and V. Papastavrou. 1989. Diving behavior of the sperm whales, (*Physeter macrocephalus*), off the Galapagos Islands. Canadian Journal of Zoology 67(4): 839-846.

Williams, R., D. E. Bain, J. K. B. Ford and A. W. Trites. 2002. Behavioural responses of male killer whales to a 'leapfrogging' vessel. Journal of Cetacean Research and Management 4(3): 305-310.

Williams, T. M., R. W. Davis, L. A. Fuiman, J. Francis, B. B. J. Le, M. Horning, J. Calambokidis and D. A. Croll. 2000. Sink or swim: Strategies for cost-efficient diving by marine mammals. Science Washington D C 288(5463): 133-136.

Winn, H. E., J. D. Goodyear, R. D. Kenney and R. O. Petricig. 1995. Dive patterns of tagged right whales in the Great South Channel. Cont. Shelf. Res. 15(4/5): 593-611.

Witteveen, B. H., R. J. Foy, K. M. Wynne and Y. Tremblay. 2008. Investigation of foraging habits and prey selection by humpback whales (*Megaptera novaeangliae*) using acoustic tags and concurrent fish surveys. Marine Mammal Science 24(3): 516-534.

Woodley, T. H. and D. E. Gaskin. 1996. Environmental characteristics of North Atlantic right and fin whale habitat in the lower Bay of Fundy, Canada. Canadian Journal of Zoology 74(1): 75-84.

Würsig, B., R. Wells and D. Croll. 1986. Behavior of gray whales summering near St. Lawrence Island, Bering Sea. Canadian Journal of Zoology 64(3): 611-621.

Würsig, B. and M. Würsig. 1979. Behavior and Ecology of the bottlenose dolphin, (*Tursiops truncatus*) in the South Atlantic. Fishery Bulletin 77(4): 399-412.

Wyrick, R. 1954. Observations on the movements of the Pacific gray whale *Eschrichtius glaucus*. Journal of Mammalogy 35(4).

Yin, S. E. 1999. Movement patterns, behaviors, and whistle sounds of dolphin groups off Kaikoura, New Zealand. M.S. thesis, Texas A & M University, College Station, TX 107 pp.

APPENDIX D
ANALYSIS OF SURTASS LFA SONAR MARINE MAMMAL OFFSHORE BIOLOGICALLY IMPORTANT AREAS

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APPENDIX D-1: NMFS' INITIAL INSTRUCTIONS TO MARINE MAMMAL OBIA SUBJECT MATTER EXPERTS (SMES), 23 NOVEMBER 2009

To: Subject Matter Experts

From: NMFS Office of Protected Resources

Re: Identifying Marine Mammal Offshore Biologically Important Areas (OBIAs) for Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) Sonar.

Thank you for agreeing to participate and lending your expertise to this important process. We have prepared these notes in advance of our introductory meeting to explain what the process will entail and to help guide your recommendations.

Background

The U.S. Navy plans to operate four SURTASS LFA sonars that have the potential to adversely impact marine mammals. In order to ensure Marine Mammal Protection Act (MMPA) compliance, the Navy has applied for in the past, and NMFS has issued, MMPA regulations and "incidental take" authorizations that allow for impacts to marine mammals, while prescribing measures to minimize impacts. NMFS' rulemaking for the next five-year period of authorizations will begin in the near future. In preparation for that upcoming rule making, and taking into consideration court decisions issued in litigation over previous NMFS and Navy actions for SURTASS LFA sonar, NMFS and the Navy are developing a more systematic process for designating marine mammal "offshore biologically important areas" (OBIAs) for SURTASS LFA sonar. OBIAs are part of a suite of measures used in previous authorizations to minimize impacts to marine mammals. NMFS has enlisted the assistance of subject matter experts (*Experts*) to help in this process.

NMFS and the Navy will apply the best available science (including input from *Experts*) to identify OBIA Nominees and comparatively score their habitat value. Subsequently and separately, NMFS and the Navy will conduct a "practicability" assessment in accordance with the MMPA, which will rely on operational information provided by the Navy.

Process Summary for *Expert* Input

Stage 1. Identification of OBIA Nominees using Screening Criteria

a. NMFS used Screening Criteria to review existing and potential Marine Protected Areas and prior OBIAs to produce a List of Preliminary OBIA Nominees

b. *Experts* will use the same Screening Criteria to identify additional preliminary OBIA Nominees, as appropriate, and offer modifications or deletions to NMFS' List of Preliminary OBIA Nominees, if needed

c. NMFS will incorporate *Expert* input, as appropriate, to produce the final OBIA Nominees, which will be included for consideration in the Navy's 2009 draft supplemental environmental impact statement (DSEIS) for SURTASS LFA sonar.

Stage 2. OBIA Nominee Habitat Scoring

a. NMFS will seek preliminary *Expert* input regarding what factors are important for assessing comparative value (scoring) of the habitat in an OBIA Nominee.

b. At a later point, NMFS will request additional *Expert* input regarding Scoring Criteria and ask the *Experts* to comparatively score the habitat in each of the OBIA Nominees (e.g., by placing nominees in one of two or three categories).

c. NMFS will synthesize expert input and assign comparative Habitat Score for each OBIA Nominee.

Screening Criteria for Identification of OBIA Nominees

NMFS developed Screening Criteria to be used in Stage 1 to determine whether a suggested area is eligible to be considered as an OBIA Nominee. NMFS anticipates that the *Experts* will use peer-reviewed literature, technical reports, or his/her own specific expertise and professional experience, along with other data sources to justify their additions, modifications, or deletions to the list of preliminary OBIA Nominees. The Screening Criteria are described below.

Criterion 1: Outside of Coastal Standoff Distance and Non-Operational Areas

The Navy has indicated that it will not operate LFAS in certain areas of the world. No analyses will be conducted in these areas and OBIAs will not be designated that lie solely within these areas. The areas where the Navy will not operate SURTASS LFA are as follows:

- Coastal Standoff Zone - the area within 12 nm of any coast
- Non-Operational Areas:
    - Arctic –Portions of the Norwegian, Greenland, and Barents Seas, North of 72^{o} North latitude, plus Baffin Bay, Hudson Bay, the Bering Sea and the Gulf of St. Lawrence.
    - Antarctic –South of 60^{o} South latitude

Criterion 2: Biologically Important

In order to be an OBIA Nominee, an area must meet at least one of the below sub-criteria.

2a. *High Densities*

The area represents an area of high density for one or more species of marine mammals. In addition to survey data, predictive habitat or density modeling may be used to identify areas of high density. The exact definition of “high density” may differ across species and should generally be treated and justified on a stock-by-stock or species-by-species basis, although combining species or stocks may be appropriate in some situations, if well justified.

In identifying high density areas:

(1) For locations/regions and species for which adequate density information is available (e.g., most waters off the United States), high density areas should be defined as those areas where density measurably, within a definable and justifiable area, meaningfully exceeds the average density of the species or stock in that location/region regularly or regularly within a designated time period of the year.

(2) For locations/regions and species and stocks for which density information is limited or not available, high density areas should be defined (if appropriate) using some combination of the following: available data, regional expertise, and/or habitat suitability models utilizing static and/or predictable dynamic oceanographic features and other factors that have been shown to be associated with high marine mammal densities.

NMFS will work with *Experts* to ensure that all locations and regions within the Navy's operating area are addressed.

2b. *Known, Defined Breeding/Calving Grounds, Foraging Grounds, and Migration Routes*

The area includes known, defined breeding or calving areas, foraging grounds, concentrated migration routes, and any designated critical habitat.

2c. *Small, Distinct Populations with Limited Distributions*

The area contains a small, distinct population of marine mammals with limited distribution.

NMFS' Preliminary OBIA Nominee Recommendations

NMFS and the Navy have evaluated several references (including, primarily, Marine Protected Areas(MPAs)) and compiled a List of Preliminary OBIA Nominees that we think meet the Screening Criteria. This list is not comprehensive: rather, it captures some of the more well-known important marine mammal areas and clearly lays out our suggested format for this process. *We fully expect the Experts may identify some less well-known areas, and we also understand that some areas will have less information available than the more well-known MPAs included in NMFS' List of Preliminary OBIA Nominees.* See Attachments 1 and 2.

OBIA Nominee Habitat Scoring (Stage 2)

After NMFS incorporates the *Expert* input, as appropriate, to produce the final OBIA Nominees, NMFS will ask the *Experts* to score the OBIA Nominee habitat (into two or three categories). Additional details will be provided to the *Experts* in the instructions below (preliminary data-gathering) and at a later date prior to the second stage of *Expert* input.

Detailed Instructions for First Round of *Expert* Input

1. General

As a general rule, *Experts* will need to submit their information individually and independently. NMFS may consider asking Federal *Experts* to submit a joint recommendation, which would focus and streamline the efforts of both the Federal *Experts* and NMFS HQ analysts. However, this would require that one or two Federal *Experts* take a leadership role and we realize that it would need to be discussed at the Introductory Meeting.

As a starting point, NMFS and the Navy have compiled a List of Preliminary OBIA Nominees[7]. Attachment 1 (Screening Matrix) indicates the areas that NMFS and the Navy considered in our preliminary analysis, and whether we think they are eligible to be OBIA Nominee based on our preliminary analysis of whether they meet the Screening Criteria outlined in the Introduction above. Attachment 2 (Detailed Screening Document for Eligible OBIA Nominees) provides more detailed supporting information for all of the sites that were considered in the preliminary analysis, including the sites that were found eligible to be a Preliminary OBIA Nominee.

[7] The frequencies of the signals produced by SURTASS LFA sonar (frequency range of 100 to 500 Hz) are much lower than the frequencies of greatest hearing sensitivity for high frequency and mid-frequency marine mammal hearing groups (as defined in Southall et al., 2007). There are few known data documenting responses of these marine mammal hearing groups to SURTASS LFA sonar. In Stage 1 NMFS and the *Experts* will initially identify all potential OBIA nominees that meet the screening criteria, regardless of the hearing sensitivity of the species for which the area is important. Further assessments will be performed to determine whether areas that only meet the screening criteria for high and/or mid-frequency hearing specialists should be designated as OBIAs based on analyses of the specific species present and other relevant factors.

2. Adding and Modifying Preliminary OBIA Nominees

To recommend additional Preliminary OBIA Nominees or to modify or delete from NMFS' List of Preliminary OBIA Nominees, please do the following:

a) Provide an introductory list with the names of any new Preliminary OBIA Nominees you are recommending and any areas from NMFS' initial list that you have recommended modifying.
b) In the Screening Matrix (Attachment 1), add rows with information for newly recommended Preliminary OBIA Nominees in RED, and make any changes to existing information in RED.
c) To support recommended additions, modifications, or deletions to the Screening Matrix (based on the criteria definitions included in the Introduction), please make **track changes** in the Detailed Screening Document (Attachment 2) to include the following:
    - The information that supports each addition, modification, or deletion (e.g., each yes to a criterion should be specifically supported for each associated species, along with the recommended boundaries, etc.).
    - The appropriate way to cite any information provided.
    - A map of the boundaries, if possible (note – please indicate the actual estimated boundaries of the area of biological importance or high density: do not add a buffer)
    - Note - For brand new areas, please use the format provided in the Detailed Screening Document for the existing areas, i.e., with the boxes at the top that contain criteria met, species, etc.
    - Note – Only indicate a species in the Screening Matrix or in the box at the top of the page in Detailed Screening Document if the area meets one of the biological importance criteria for that species.
d) If habitat modeling is used as a basis for the addition, modification, or deletion of a Preliminary OBIA Nominee, please also include a description of the modeling methodology that includes the following information: a description of the individual factors/parameters that were used in the analysis; a description of how each factor is considered by the model (weight, etc.); and a description of any assumptions made in the model. Please provide citations for existing models that have been addressed in the literature and, if possible, supporting citations for the parameters used in any new models.

3. Preliminary List of Habitat Scoring Factors

As mentioned in the Process Summary for *Expert* Input, sometime after NMFS has incorporated *Expert* input to produce the final OBIA Nominees, we plan to ask *Experts* to help score the habitat. NMFS has compiled a preliminary list of some of the factors that should likely be considered in the comparative scoring of habitat. In the second stage of *Expert* input, NMFS will provide a habitat scoring method and request that you score the habitat in each of the final OBIA nominees.

For now, we ask that the *Experts* review the preliminary list of factors below that would likely contribute to habitat ranking and recommend additions, modifications, or deletions, as well as any other information we should consider when devising a method to rank habitat (such as the importance of some factors compared to others):

- The comparative habitat value of the identified area to the associated species (meaning the ones for which criteria are met), for example:
    - a known calving ground may have a greater weight than general high density, or
    - the single known calving ground in the world for a particular species may have a greater weight than one of twenty known for another species (so, for example, we may ask *Experts* to rank calving grounds as 1, 2, or 3)
- Total number of associated stocks/species in an area for which criteria 2a, 2b, or 2c were met
- Whether individual associated species are listed under the Endangered Species Act or on the IUCN Red List, or, if applicable but not reflected in ESA/IUCN listing: have known upward/downward population trends or have relatively low or high abundance.

- Whether any of the species for which the area is important are known to be either more or less sensitive to low frequency sound either physiologically or behaviorally.

Information to be Provided to NMFS

To recap, *Experts* should submit their information independently (unless we work out that Federal *Experts* will submit a combined report, per introductory discussion), which will include the following:

- A brief list of the added, modified, or deleted Preliminary OBIA Nominees
- The Screening Matrix with additions, modifications, or deletions indicated in RED (strikethrough if deleted)
- The Detailed Screening Document with supporting information for additions, modifications, or deletions, and associated citations, in **track changes**.
- Where habitat modeling is used, an additional description of the methodology used
- Coordinates (and also, ideally, maps, ESRI shapefiles, or Google kml files) indicating boundaries of added or modified areas
- A list of the factors and other information that should be used to score habitat in OBIA Nominees

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APPENDIX D-2: DETAILED SCREENING DOCUMENT FOR ELIGIBLE OBIA NOMINEES, 23 NOVEMBER 2009

NMFS' Initial Screening Analysis for Marine Mammal Offshore Biologically Important Areas (OBIA) for the Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active Sonar (LFA)

Detailed Screening Document for Eligible OBIA Nominees

National Marine Fisheries Service
Office of Protected Resources
November 19, 2009

IUCN Marine Region 3: Mediterranean Sea

Northeast Slope in the Ligurian-Corsican-Provençal Basin

Potential Criterion:	2B: Foraging Area
Species of Concern:	Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: Location inferred from Azzellino et al. (2008).	8°35'23.085"E, 43°57'14.637"N 9°6'36.592"E, 43°56'30.726"N 9°6'21.955"E, 43°26'45.04"N 8°35'37.721"E, 43°26'59.677"N *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	July through August

Background

- The total size of the fin whale population in the Mediterranean is unknown. However, one study estimates that approximately 3500 individuals range in a portion of the western basin. High whale densities, comparable to those found in rich oceanic habitats, were found in well-defined areas of high productivity. Most whales concentrate in the Ligurian-Corsican-Provençal Basin; however, neither their movement patterns throughout the region nor their seasonal cycle are clear (Notarbartolo-Di-Sciara, Zanardelli, Jahoda, Panigada, & Airoldi, 2003).
- During the summer months, the species is known to concentrate in high numbers in the Corso-Ligurian Basin, described as one of the principal feeding grounds for fin whales in the Mediterranean Sea (Notarbartolo-Di-Sciara, et al., 2003)
- One nine-year study surveyed a total of 73,046 km and reported 540 sightings of fin whales in the Ligurian Sea. Water depth was the most significant variable in describing fin whale distribution, with more than 90% of sightings occurring in waters deeper than 2,000m (Panigada, et al., 2005).
- One study sought to correlate marine mammal presence in the Ligurian Sea with physical and biological parameters collected during NATO’s SACLANT Undersea Research Centre’s sea trials, called Sirena. The data suggested that large (sperm and fin) whales were predominately found in the deeper portion of the basin (D' Amico, et al., 2003).
- In the western Ligurian Sea, many submarine canyons at the boundary between neritic and oceanic domains create the conditions for the accumulation of migratory micronektonic species in the continental slope waters. One study suggests that the periodic pattern of concentration of pelagic zooplankton near the bottom above the slope may provide an abundant food source for organisms living in the slope area, and it could also be the reason for the occasional presence of fin whales over the upper slope (Azzellino, Gaspari, Airoldi, & Nani, 2008)
- Most of the fin whale sightings occurred along the 2000-m depth contour. Also, Fin whales showed also a periodic east-to west pattern in their movements during the July–August period. Such a pattern suggests once more a relationship with the counter-clockwise circulation of the Liguro-Provenc- al-Catalan Current (Azzellino, et al., 2008).
- Azzellino et al. (2008) noted that bottlenose dolphin, Risso’s dolphin, sperm whale and Cuvier’s beaked whale were all found associated with well-defined depth and slope gradients showing very clear preferences for specific physical habitats, respectively, the shelf-edge, the upper slope and the lower slope.

IUCN Marine Region 4: Northwest Atlantic Ocean

Northwest of Challenger Bank (Bermuda)

Potential Criteria:	2B: Migration Route 2B: Foraging Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration: Location inferred from Stone et al. (1987)	A 5-km buffer around the centroid of: 65°19'11.214"W, 32°12'16.23"N *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	March and April

Background

- Historical accounts show that humpback whales have frequented Bermuda waters, which are located half-way between wintering and summering grounds in the western North Atlantic, since the early 17th century (Stone, Katona, & Tucker, 1987). Stone et al. suggested that humpback whales from the North Atlantic feed briefly and opportunistically at Bermuda (32°20'N) while migrating (Danilewicz, Tavares, Moreno, Ott, & Trigo, 2009).
- Humpback whales were common in Bermudian coastal waters during the late winter and spring (March-May); sperm whales, in offshore waters probably throughout much of the year (Reeves, Mckenzie, & Smith, 2006)
- Humpbacks utilize Bermuda as a mid-ocean habitat through which all members of the western North Atlantic population migrate during spring (Stone, et al., 1987).
- Humpbacks returning to their northern feeding grounds may take more westerly routes that in many cases pass close to Bermuda where as suggested by Stone et al. (1987), they may linger and feed (Clapham & Mattila, 1990).
- Stone et al. (1987) suggest that the presence of humpbacks at Bermuda, a way-point during the springtime northward migration, may be attributed to increased food availability, providing the first opportunity to feed after the wintering ground fast (Baraff, Clapham, Mattila, & Bowman, 1991).
- There is also evidence suggesting that humpback whales feed at Bermuda on deep water scattering layers during their stop-over (Stone, et al., 1987).
- It seems likely that humpbacks returning to their northern feeding grounds may take more westerly routes that in many cases pass close to Bermuda where, as suggested by Stone et al. (1987), they may linger and feed (Clapham & Mattila, 1990).

Roseway Basin Right Whale Conservation Area (Canada)

Potential Criterion:	2B: Foraging Grounds
Species of Concern:	North Atlantic right whale (*Eubalena glacialis*)
Proposed Boundary Consideration: Basis: Canadian Government.	An area bounded by the following coordinates: NW 43° 05'N, 65° 40'W NE 43° 05'N, 65° 03'W SW 42° 45'N, 65° 40'W SE 42° 45'N, 65° 03'W
Proposed Seasonal Consideration:	TBD *(Canadian Restriction is June through December)*

Background

- In 2008, Transport Canada implemented the Roseway Basin Area to be Avoided (ATBA) following its adoption by the International Maritime Organization (IMO). The measure is seasonal and recommended for all vessels ≥ 300 gross tonnage from June through December. The aim of this ATBA is to protect the endangered North Atlantic right whale from ship strikes and to enhance maritime safety (IMO, 2007).
- From 1999 to 2001, Baumgartner et al. (2003) conducted surveys in Roseway Basin to investigate the physical and biological oceanographic factors associated with North Atlantic right whale occurrence. They noted that right whales in these regions fed on *Calanus finmarchicus*.
- Spatial variability in right whale occurrence was associated with water depth and the depth of the bottom mixed layer. *C. finmarchicus* CS aggregated over the deepest water depths in both regions, and within these areas, right whales occurred where the bottom mixed layer forced discrete layers of *C. finmarchicus* to occur shallower in the water column (allowing more efficient foraging) (Baumgartner, Cole, Clapham, & Mate, 2003).
- Baumgartner et al. (2003) concluded that annual increases in right whale occurrence appeared to be associated with decreases in sea surface temperature (SST) in both regions; however, they any further observation merits based on the short duration of the three-year study.
- Baumgartner et al. (2003) concluded that spatial variability in right whale occurrence was associated with water depth and the depth of the bottom mixed layer, within the Bay of Fundy and Roseway Basins. Copepods (*Calanus finmarchicus*) aggregated over the deepest water depths in these areas. Within these areas, right whales occurred where the bottom mixed layer forced discrete layers of *C. finmarchicus* to occur shallower in the water column, which allows more efficient foraging.
- The spatial and interannual variability in occurrences observed for right whales might be associated with the SST gradient, a proxy for ocean fronts (Baumgartner, et al., 2003).
- The summer feeding areas are in waters near Nova Scotia and the principal spring feeding ground (April-June) is in the GSC (Kenney & Wishner, 1995).

Great South Channel (United States)

Potential Criteria:	2B: Critical Habitat 2B: Foraging Area
Species of Concern:	North Atlantic right whale (*Eubalena glacialis*)
Proposed Boundary Consideration: Basis: U.S. Government.	It is bounded by the following coordinates: 42°30′00.0″ N, 069°45′00.0″ W 41°40′00.0″ N, 069°45′00.0″ W 41°00′00.0″ N, 069°05′00.0″ W 42°09′00.0″ N, 067°08′24.0″ W 42°30′00.0″ N, 067°27′00.0″ W 42°30′00.0″ N, 069°45′00.0″ W *This area is within designated critical habitat.*
Proposed Seasonal Consideration:	TBD *(Ship Strike Rule is April 1 to July 31)*

Background

- The Great South Channel (GSC) area lies east of Cape Cod, Massachusetts, U.S.A. between Nantucket Shoals on the west and Georges Bank on the east. Right whales are the world's most endangered large whale species, and the GSC is the principal feeding ground of the western North Atlantic population (Kenney & Wishner, 1995).
- The South Channel Ocean Productivity Experiment (SCOPEX), a multidisciplinary study of a whale-zooplankton predator-prey system in the southwestern Gulf of Maine, confirmed the co-occurrence of right whales with high density *Calanus finmarchicus* patches. Also, the whales fed on patches with higher proportions of larger lifestages of *C. finmarchius* (Kenney & Wishner, 1995).
- The summer feeding areas are in waters near Nova Scotia and the principal spring feeding ground (April-June) is in the GSC (Kenney & Wishner, 1995).
- Right whales were only rarely observed in the GSC during the fall and winter seasons. Most sightings occurred in April, May, and June, with a large peak in sighting frequency in May (Kenney, Winn, & Macaulay, 1995).
- In the Great South Channel Seasonal Management Area, NOAA has proposed an April through July requirement that all vessels over 300 gross tons travel no faster than 10 knots. To physically separate whales and vessels, NOAA has also considered designating the Great South Channel critical habitat area as an International Maritime Organization-approved Area To Be Avoided (ATBA). NMFS proposed seasonal restriction of the April through July based on the number of greatest sighting densities found in the southwest corner of the GSC Critical Habitat (Merrick & Cole, 2007)**.**
- NMFS designated this area as critical habitat and an important feeding area for the North Atlantic right whale in 1994 (NMFS, 1994).

The Gully Marine Protected Area (Canada)

Potential Criteria:	2A: High Density 2B: Foraging Grounds
Species of Concern:	Northern bottlenose whales (*Hyperoodon ampullatus*)
Proposed Boundary Consideration: Basis: Canadian Government	An area bounded by the following coordinates: 44°13′ N, 59°06′ W to 43°47′ N, 58°35′W; 43°35′ N, 58°35′ W to 43°35′ N, 59°08′ W to 44°06′ N, 59°20′ W
Proposed Seasonal Consideration:	Year Round

Background

- The Gully, a submarine canyon off eastern Canada, was nominated as a pilot Marine Protected Area (MPA) in 1998, largely to safeguard the vulnerable population of northern bottlenose whales (Hooker, Whitehead, & Gowans, 2002).
- Northern bottlenose whales are consistently found through the year in the Gully (Whitehead, Gowans, Faucher, & McCarrey, 1997).
- A small, apparently isolated, and endangered population of approximately 130 northern bottlenose whales is found on the Scotian Slope south of Nova Scotia, Canada (Wimmer & Whitehead, 2004).
- A ship survey along the 1000 m depth contour in 2001 showed northern bottlenose whales only in the Gully, Shortland Canyon, and Haldimand Canyon. Studies in 2002 reconfirmed the presence of the whales in the other canyons, although densities were about 50% lower than in the Gully (Wimmer & Whitehead, 2004)
- Hooker et al. (2002) estimated the energy consumption of bottlenose whales in The Gully and suggested that there must be a substantial spatial subsidy in the underlying food web of the submarine canyon to support the bottlenose whales using the Gully.
- Studies of this species' diet elsewhere in the North Atlantic Ocean have suggested specialization on the deep-sea squid, *Gonatus fabricii* (Hooker, Iverson, Ostrom, & Smith, 2001).

Shortland Canyon and Haldimand Canyon (Canada)

Potential Criteria:	2A: High Density 2B: Foraging Grounds
Species of Concern:	Northern bottlenose whales (*Hyperoodon ampullatus*)
Proposed Boundary Consideration: Location inferred from Wimmer and Whitehead (2004)	An area bounded by the following coordinates: 58°38'16.385"W, 44°11'56.984"N 57°54'5.541"W, 44°31'42.32"N 57°42'35.89"W, 44°8'43.019"N 58°29'39.147"W, 43°50'23.889"N
Proposed Seasonal Consideration:	Year Round

Background

- On the Scotian Shelf, northern bottlenose whales have been sighted most often in the deep waters of three underwater canyons (the Gully, Shortland Canyon, and Haldimand Canyon) along the shelf edge. They are thought to be year-round residents but winter distribution is not understood (DFO, 2007)
- The carrying capacity (the maximum number of individuals that a given environment can support) of northern bottlenose whales on the Scotian Shelf is unknown. The density of whales is higher in the Gully than in the other two canyons. This could indicate that there is room for population expansion in Shortland and Haldimand canyons. However a large canyon such as the Gully can have proportionately higher productivity due to its oceanographic and bathymetric (ocean depths) characteristics suggesting that it would be able to support higher densities of whales than smaller canyons (DFO, 2007).
- Haldimand and Shortland canyons are clearly important habitat for this species, and should receive appropriate protection. Research in 2002 confirmed that northern bottlenose whales regularly use Shortland and Haldimand canyons (Wimmer & Whitehead, 2004).
- Northern bottlenose whales were encountered in Shortland and Haldimand canyons at a rate about half that in The Gully, which suggests about half the density. Also, the whales seem to prefer waters between about 800 and 1500 m deep within all three canyons (Wimmer & Whitehead, 2004).
- Although there have been several sightings of northern bottlenose whales in other areas on and surrounding the Scotian Slope, the only areas in which we know they can be reliably found are the Gully and Shortland and Haldimand canyons (Wimmer & Whitehead, 2004) .
- Northern bottlenose whales do move between the three canyons. The function of this movement can be considered from the perspective of optimal foraging on dispersed patches of prey. As the Gully (the richer patch) fills with more northern bottlenose whales, individuals would likely do better in terms of individual net gain to use other, albeit poorer, areas with fewer competitors (Haldimand and Shortland canyons and other areas (Wimmer & Whitehead, 2004).

IUCN Marine Region 5: Northeast Atlantic Ocean

Dogger Bank (OSPAR International)

Potential Criterion:	2A: High Density
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration:	TBD
Proposed Seasonal Consideration:	TBD

Background

- In 2002 and 2003, Germany's Federal Agency for Nature Conservation (BfN) conducted aerial surveys in the German EEZ and 12 nm zone to assess proposed Sites of Community Importance under the European Union (EU) Habitats Directive. The BfN found that the densities estimated for this site were fairly high, indicating an important area for porpoises. Also, Dogger Bank was the only area where sightings of other species could be observed (white-beaked dolphin and minke whale) (Gilles, Scheidat and Siebert, 2008).
- Other studies (Siebert, et al., 2006) have collected data on the occurrence of harbour porpoises in German waters from 1988 to 2002 from dedicated aerial surveys, incidental sightings and strandings. In the article, Siebert et al. notes that aerial surveys conducted in 1995 and 1996 revealed a mean abundance of 4288 (in 1995) and 7356 harbour porpoises (in 1996) in the German North Sea study area. Further, they describe reports of 791 incidental sightings of harbour porpoise pods in German and partly Danish coastal waters of the North and Baltic Seas from 1988 to 2002.
- Siebert et al. (2006) also found that 996 harbour porpoise strandings along the German North Sea coast in the period 1990 to 2001. Only 17 animals were identified as by-catch.
- Siebert et al. (2006) noted that their observational data demonstrated a strong seasonality of harbour porpoise occurrence off the German coast with highest numbers during the summer months.

Sylt Outer Reef (Germany)

Potential Criteria:	2A: High Density 2B: Calving Grounds
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration:	TBD
Proposed Seasonal Consideration:	TBD

Background

- In 2002 and 2003, Germany's Federal Agency for Nature Conservation (BfN) conducted aerial surveys in the German EEZ and 12 nm zone to assess proposed Sites of Community Importance under the European Union (EU) Habitats Directive. The BfN found that the densities estimated for this site were fairly high, indicating an important area for porpoises.
- Giles et al. (2008) noted that the highest density was estimated for Sylt Outer Reef (2002: 2.7 individuals/km^2; 2003: 3.7 individuals/km^2).
- Important habitats for harbour porpoises were detected west of the islands of Sylt and Amrum in the North Sea and around the Schlei estuary, in waters west of Fehmarn and the Fischland-Darss area in the Baltic Sea (Siebert, et al. 2006).
- In the BfN evaluation of sites in the North Sea, only the Sylt Outer Reef was delineated for porpoises using the criteria of Article 4.1 Habitats Directive. There, three selection criteria were positively validated: (1) continuous or regular presence, (2) good population density, and (3) a high ratio of mother-calf pairs (60%) (Gilles, Scheidat and Siebert, 2008).

IUCN Marine Region 6: Baltic Sea

Pommeranian Bay, Adler Ground, and Western Ronne Bank (Germany)

Potential Criterion:	2B: Breeding Area
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration:	TBD
Proposed Seasonal Consideration:	TBD

Background

- The harbor porpoise is the only resident cetacean species in the German Baltic Sea (Scheidat, et al. 2008).
- One study (Verfuss, et al. 2007) indicated regular presence of harbor porpoises within the Baltic Sea and noted that the porpoise usage patterns of the area indicated geographical and seasonal variation.
- In contrast, Scheidat, et al.(2008) found no obvious seasonal patterns and reported low densities for the area that includes the Pommeranian Bay, Adler Ground, and Western Ronne Bank, ranging from 0 to 0.008 ind. km^2 during all but 2 surveys (July 2002 and April 2005). During the July 2002 survey, the author notes that an unusually high number of porpoises were seen east of the island of Rugen with a mean group size of 2.63. However, the author and others (Gilles, Scheidat and Siebert 2008) note that the event was an unusual and that the most likely explanation for the observed hot spot in May and July 2002 mighthave been an unusual availability of food (Gilles, Scheidat and Siebert 2008). Finally, density of porpoises declined from west to east during all other study months and years, with the highest densities west of Pommeranian Bay, Adler Ground, and Western Ronne Bank (Scheidat, et al. 2008).
- The larger numbers of harbor porpoise detections in spring to autumn compared with winter suggests that the German Baltic Sea is an important breeding and mating area for these animals (Verfuss, et al. 2007).
- A recent Danish effort (http://www2.dmu.dk/Pub/FR657.pdf) to designate and identify areas of high harbor porpoise density has collected all relevant data on movements and density of the harbor porpoises in Danish and adjacent waters.

IUCN Marine Region 7: Caribbean

Southeastern U.S. Right Whale Seasonal Habitat (United States)

Potential Criteria:	2B: Calving Area 2B: Designated Critical Habitat
Species of Concern:	North Atlantic right whale (*Eubalena glacialis*)
Proposed Boundary Consideration: Basis: U.S. Government	The coastal waters between 31°15'N and 30°15' N from the coast out 15 nautical miles; and the coastal waters between 30°15' N and 28°00' N from the coast out 5 nautical miles. *This area is within designated critical habitat.*
Proposed Seasonal Consideration:	November through March

Background

- NMFS has designated critical habitat for the NARW in coastal waters of the southeastern United States (SEUS) (NMFS 1994). This area is the only known calving ground for NARW off the SEUS in the winter (Kraus, Hamilton, Kenney, Knowlton, & Slay, 2001).
- The NARW calving season extends from late November through early March with an observed peak in January. The presence of females with calves was primarily limited to the coastal waters between 27°30'N and 32°00'N latitudes (NMFS, 1994).
- Based on the number of calves and females with calves in the SEUS since 1980, NMFS considers the SEUS as the primary calving area for the population (NMFS, 1994).
- Keller et al. (2006) found that SST likely plays an important role in the distribution of right whales in the southeastern, winter habitat. Warm Gulf Stream waters, generally found south and east of delineated critical habitat, represent a thermal limit for right whales and play an important role in their distribution within the calving grounds (Keller, et al., 2006).

Silver Bank and Navidad Bank (Dominican Republic)

Potential Criteria:	2B: Breeding Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration: Location inferred from Whitehead (2009).	An area bounded by the following coordinates: 70°1'44.244"W, 20°54'55.121"N 69°39'45.454"W, 20°55'36.078"N 68°46'39.063"W, 20°17'6.149"N 68°31'13.453"W, 19°48'1.415"N 69°3'18.394"W, 19°55'40.124"N 70°2'8.817"W, 20°16'17.001"N *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	December through April

Background

- One survey conducted between 14 February and 19 March 1984 reported 317 whales were individually identified from photographs of ventral fluke patterns. Analysis of matches suggests that whales from the various high-latitude feeding stocks mix randomly on Silver Bank. Overall, the number of whales, calves, and surface-active groups observed during this study confirms the apparently singular importance of Silver Bank to the breeding ecology of western North Atlantic humpback whales (Mattila, Clapham, Katona, & Stone, 1989).
- Scott and Winn (1977) conducted aerial surveys of Silver Bank in February, 1976 and reported that the estimated number of animals on the upper half of Silver Bank ranged from 405 to 618 individuals.
- Fast moving groups containing three or more adult humpback whales are found in the winter on Silver Bank in the West Indies. Many of these gr(Mattila, et al., 1989)oups have a definite structure: a central Nuclear Animal, with or without a calf, is surrounded by escorts who compete, sometimes violently, for proximity to the Nuclear Animal (Tyack and Whitehead 1983).
- The humpback whales, which winter in the West Indies are principally found over banks which are at latitudes between 10° and 22° N, have substantial areas of flat bottom between 15 and 60 m deep, and lie less than 30 km from the North Atlantic 2000-m contour. The surface sea temperatures in these areas are between 24 and 28° C (Whitehead and Moore 1982).
- The major concentrations of the humpbacks, which feed little in winter, are on Silver and Navidad banks. On Silver Bank the humpback and humpback song densities peak in the centre of the Bank. Mothers with calves are generally found in areas of calm water, and singers are found over areas with a flat bottom, where they meander slowly. There is no evidence of whales possessing particular movement patterns, preferred ranges, or territories within the Bank. The concentration of humpbacks may be a significant feature for other humpbacks (Whitehead and Moore 1982).
- As part of a large-scale assessment called More of North Atlantic Humpbacks (MoNAH) project, extensive sampling was conducted on humpbacks in the Gulf of Maine/Scotian Shelf region and the primary wintering ground on Silver Bank during 2004-2005. The work is intended to update the YONAH assessment in preparation for a possible status review under the Endangered Species Act (Waring, Josephson, Fairfield-Walsh, & Maze-Foley, 2009).

IUCN Marine Region 13: East Asian Sea

Area in the Ombai Strait in the Savu Sea Marine Protected Area (Indonesia)

Potential Criteria:	2B: Migration Route 2B: Feeding Grounds
Species of Concern:	Blue Whale (*Balaenoptera musculus*) Sperm whale (*Physeter macrocephalus*)
Proposed Boundary Consideration: Location inferred from Pet Soede (2002)	124°19'2.12"E, 8°40'3.814"S 125°0'5.731"E, 8°32'35.885"S 124°49'57.827"E, 8°46'59.748"S 124°26'46.047"E, 8°57'55.645"S *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	June through September

Background

- The Indonesian Marine Affairs and Fisheries Minister Freddy Numberi announced the designation of the Savu Sea National Marine Park — a blue whale hotspot, in May 2009.
- There is little species information on this area. However, The Nature Conservancy has sponsored the Solor-Alor Visual and Acoustic Cetacean Survey & Research Program in this area since 2001. Their studies consider the southeastern cape of Alor and the entrance of Ombai Strait, is considered to be a wide and important migratory corridor between Alor and East Timor (Pet Soede 2002).
- Initial comparisons between blue whale sightings south of Alor (Savu Sea) and north of Komodo (Flores Sea) suggests that blue whales enter and exit Indonesian Seas through different routes and corridors; perhaps initially migrating east towards Ombai Strait, between E Alor and Timor, and then move into the Banda Sea (Pet Soede 2002).
- The Savu Sea is located in eastern Indonesia at the nexus of the Pacific and Indian Oceans. However, many researchers believe that it is may be a significant area for oceanic cetaceans in the Indonesian Seas (Kahn 2008).
- The small passages between the Solor-Alor Islands in the Savu Sea are considered feeding grounds and corridors for cetacean migration (Mustika 2006).
- Two traditional communities (Lamalera village on Lembata Island and Lamakera village on Solor Island) hunt whales in the Savu Sea, a practice which impacts on marine mammal populations but which is poorly documented (Mustika 2006).

IUCN Marine Region 14: South Pacific

Penguin Bank (Hawaii)

Potential Criteria:	2A: High Density 2B: Breeding Area
Species of Concern:	Humpback whales (*Megaptera novaeangliae*)
Proposed Boundary Consideration: Location inferred from Mobley (2001)	157°30'58.217"W, 21°10'2.179"N to 157°30'22.367"W, 21°9'46.815"N to 157°31'0.778"W, 21°6'39.882"N to 157°30'30.049"W, 21°2'51.976"N to 157°29'28.591"W, 20°59'52.725"N to 157°27'35.919"W, 20°58'5.174"N to 157°30'58.217"W, 20°55'49.456"N to 157°42'42.418"W, 20°50'44.729"N to 157°44'45.333"W, 20°51'2.654"N to 157°46'4.716"W, 20°53'56.784"N to 157°45'33.987"W, 20°56'32.988"N to 157°43'10.586"W, 21°1'27.472"N to 157°39'27.802"W, 21°5'20.499"N to 157°30'58.217"W, 21°10'2.179" *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	January through April

Background

- The Hawaiian Islands Humpback Whale National Marine Sanctuary was created by Congress in 1992 to protect humpback whales and their habitat in Hawai'i. The sanctuary, which lies within the shallow (less than 600 feet), warm waters surrounding the main Hawaiian Islands, constitutes one of the world's most important humpback whale habitats (Hawaiian Islands Humpback Whale NMS, 2009)
- With the exception of a portion of Penguin Banks, the Hawaiian Islands Humpback Whale National Marine Sanctuary is located within 12 nautical miles (nm) of the islands. Penguin Bank is a shallow area of known humpback whale concentration (Mate, Gisiner, & Mobley, 1998).
- The primary period of humpback whale presence in Hawaiian waters is January through April, with peak abundance occurring earlier near the island of Hawaiʻi than the other islands (Gabriele, et al. 2003). Their report identified the highest whale densities near Keahole Point and just north of Kawaihae Harbor, and lower densities near the resorts along the shore south of Kawaihae (Gabriele, et al. 2003).
- The main Hawaiian Islands (MHI) are the primary winter reproductive area for the majority of North Pacific humpback whales. Identification photographs of individual whales, including 63 females sighted in at least 2 different years and with at least 1 calf, were collected from waters off the islands of Maui and Hawaii between 1977 and 1994 (Craig and Herman 2000).
- Calves formed a significantly larger proportion of the population off Maui than off the Big Island. The overall proportion of calves to all whales identified (crude birth rate) was 0.099 off Maui and 0.061 off the Big Island (Craig and Herman 2000).
- Aerial surveys conducted in Hawaiian waters during the winter months (Jan-Apr) of 1976-80 showed humpbacks to be most prevalent in coastal regions and shallow banks where the expanse of water less than 100-fathoms (183 m) was more extensive. Greatest densities of adult humpbacks and calf pods were found in the "four island region" (FIR) consisting of Maui, Molokai, Kahoolawe and Lanai, as well as Penguin Bank (Mobley, 2001).
- Mobley, Bauer and Herman (1999) confirmed the earlier preference of both adult humpbacks and calf pods for the FIR and Penguin Bank regions, but also showed a substantial increase of adult humpbacks in the Kauai/Niihau region (Mobley, 2001).

IUCN Marine Region 15: Northeast Pacific

Monterey Submarine Canyon (California)

Potential Criteria:	2B: Foraging Area 2B: Migration Route
Species of Concern:	Blue whale (*Balaenoptera musculus*) Pacific gray whale (*Eschrichtius robustus*) Steller sea lion (*Eumetopias jubatus*)
Proposed Boundary Consideration: Location inferred from Croll et al. (2001)	122°6'16.775"W, 36°44'31.3"N to 122°5'34.617"W, 36°35'12.717"N to 122°13'28.886"W 36°28'53.303"N to 122°28'14.186"W, 36°33'27.324"N to 122°51'25.373"W, 36°9'33.98"N to 122°58'37.484"W, 36°17'59.866"N to 122°31'55.511"W, 36°41'11.053"N
Proposed Seasonal Consideration:	December through June

Background

- In the Monterey Bay, blue whales forage as stenophagic predators of marine grazers in a simplified food web (primary producers—grazers—apex predators) (Croll, et al., 2005).
- Croll et al. (2005) examined the temporal and spatial linkages between: (1) the intensity of upwelling, (2) primary production, (3) development, density and distribution of euphausiids, and (4) the distribution, abundance, and foraging behavior of blue whales in Monterey Bay, California between 1992 and 1996. The authors found that blue whales fed exclusively upon adult euphausiids *Thysanoessa spinifera* and *Euphausia pacifica* that were larger than those generally available in the Bay.
- Croll et al. (2005) also reported that foraging whales dove repeatedly to dense euphausiid aggregations between 150 and 200 m on the edge of the Monterey Bay Submarine Canyon. In addition, euphausiid aggregations where blue whales were foraging averaged approximately 2 orders of magnitude greater than mean euphausiid densities in the Bay.
- Croll et al. (2005) also notes that high euphausiid densities are supported by high primary production between April and August and a submarine canyon that provides deep water down-current from an upwelling region.
- The cyclic annual migration of the northeastern Pacific blue whale population is associated with feeding at mid- to high-latitudes throughout the highly productive summer and fall, followed by a southbound migration to tropical regions to give birth and mate in the winter and spring. Primary production off southern California typically peaks in the spring allowing particular euphausiid species to grow to maturity by summer, coinciding with the arrival of blue whales (Burtenshaw, et al., 2004).
- Each fall, gray whales migrate south along the coast of North America from Alaska to Baja California, in Mexico, most of them starting in November or December (Rugh et al. 2001). Gray whale northbound migration generally begins in mid-February and continues through May with cows and newborn calves migrating northward primarily between March and June along the U.S. West Coast (Carretta, et al., 2008).

Cordell Bank Seamount (California)

Potential Criteria:	2B: Foraging Area 2B: Migration Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) Pacific gray whale (*Eschrichtius robustus*)
Proposed Boundary Consideration: Location inferred from NMS (2009)	123°28'45.354"W, 38°14'2.191"N 123°18'58.435"W, 37°55'55.305"N 123°26'52.318"W, 37°53'44.878"N 123°36'21.846"W, 38°11'38.722"N
Proposed Seasonal Consideration:	June through November

Background

- Cordell Bank is located about 80 kilometers (50 miles) northwest of San Francisco and 32 kilometers west of the Point Reyes lighthouse. It is approximately 7 kilometers wide and 15 kilometers long and sits on the edge of the continental shelf. The bank is located on the edge of an underwater peninsula and is surrounded by deep water on three sides. Within 11 kilometers of its western edge, the seafloor drops to 1,829 meters at the sanctuary's western boundary (NMS, 2009a).

- Vertical entrapment and/or forcing of prey near the surface likely plays a role in predator aggregation over Cordell Bank. Also, Cordell Bank is shallower than the diurnal depth range of many zooplankton species, especially euphausiids and could vertically trap these prey species in shallow regions within the diving depth of many predators (Yen, et al., 2004)

- Pacific white-sided dolphins are one of the most abundant marine mammals in the sanctuary and humpback and blue whales are regularly seen in the summer and fall, when they visit the sanctuary to feed (NMS, 2009b).

- Gray whales traverse these waters on their annual migrations between Arctic feeding grounds and Mexican breeding areas; however, in some years, many gray whales will also over-summer in the sanctuary to feed (NMS, 2009b).

- Blue and humpback whales are seasonally abundant, migrating into the sanctuary during late spring, summer and fall to feed in its productive waters. Northern fur seals and California sea lions are also seasonally abundant, coming here to forage during the fall through the spring. Smaller cetaceans (e.g., several dolphin and porpoise species) exhibit high variability in distribution, likely associated with local changes in oceanographic conditions and prey abundance (NMS, 2009b).

Area Southwest of Farrallon Islands (United States)

Potential Criteria:	2B: Migration Route 2B: Breeding Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) Pacific gray whale (*Eschrichtius robustus*) Blue whale (*Balaenoptera musculus*) Steller sea lion (*Eumetopias jubatus*)
Proposed Boundary Consideration: Location inferred from Calambokidis et al. (2000)	123°9'10.907"W, 37°46'47.697"N to 123°0'24.06"W, 37°38'55.524"N to 123°11'59.895"W, 37°30'33.529"N to 123°20'36.801"W, 37°38'15.762"N to 123°9'10.907"W, 37°46'47.697"N
Proposed Seasonal Consideration:	November through April

Background

- Large numbers of whales and dolphins, including the Pacific White-sided dolphin, the California gray whale, the endangered Pacific humpback whale, and the endangered blue whale are found in the area (NMS, 2009c).
- Gray whales migrate south through the Gulf of the Farallones beginning in November – with peak sightings during January and March. Males, newly impregnated females and juveniles come through from February through April, and females with their newborn calves follow along, from April through June. A few juveniles may appear in the gulf year-round, off the Farallon Islands and in Bodega Bay (NMS, 2009c).
- Since 1982 Steller sea lion southernmost breeding colonies are within the Monterey Bay and Gulf of the Farallones National Marine Sanctuaries at Año Nuevo Island and the Farallon Islands, respectively. Females and juveniles Steller sea lions stay within the Gulf year-round, while males migrate north and offshore during the non-breeding season from the end of August through May (NMS, 2009c).
- For a 1999 photo identification survey, Cascadia Research’s noted that out of a total of 244 identifications, of 148 unique individuals were cataloged in July, September and November in the Gulf of the Farallones region (including off Bodega Bay). Close to 50 identifications were made in the Gulf of the Farallones in August to November with most of these from a single day just west of the Farallon Islands. Finally, they were unable to find high concentrations of whales in other areas off California in 1999 (Calambokidis, et al., 2000).
- http://www.cascadiaresearch.org/reports/rep-CAL00.pdf

Southern California Bight: Tanner Bank and Cortez Bank (California)

Potential Criteria:	2B: Foraging Area 2B: Migration Route
Species of Concern:	Pacific gray whale (*Eschrichtius robustus*) Blue whale (*Balaenoptera musculus*) Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: Location inferred from NMS (2009)	119°16'27.66"W, 32°56'55.422"N 118°46'41.566"W, 32°26'42.867"N 119°2'7.689"W, 32°10'23.823"N 119°32'33.474"W, 32°40'49.608"N
Proposed Seasonal Consideration:	June through November

Background

- For blue whales, feeding was noted at a significant fraction of blue whale sightings over the shelf (out to 3.5 km beyond the 200 m isobath) in three areas: around Santa Rosa and San Miguel Islands, north of San Nicolas Island, and along the mainland coast from Pt. Conception north (Fiedler, et al., 1998)
- The results of the Whale Habitat and Prey Studies (WHAPS) show that blue whales aggregated near the Channel Islands during the summer, where they feed on dense patches of krill associated with the island shelf. Krill were most abundant along the shelf on the north and west sides of San Miguel Island and the north side of Santa Rosa Island (Fiedler, et al., 1998).
- Blue whales feed off the California coast from roughly June through November, and move southward to waters off Mexico in winter and spring (Calambokidis et al. 1990).
- Identifications of blue whales were obtained just off Point Arguello in July, in the Tanner/Cortes Bank area in the southern California Bight in August, and in the Santa Barbara Channel in August. http://www.cascadiaresearch.org/reports/rep-CAL00.pdf
- A study on visual and acoustic encounter rates for blue whales in the SAB reported elevated detection rates of in the Cortez Bank and Butterfly Bank subregions, as the dynamic bathymetry in those regions may concentrate high densities of euphausiids (Oleson, Calambokidis, Barlow, & Hildebrand, 2007). Oleson et al. also notes that the similarity in the visual and acoustic encounter rates in the Cortez Bank and Butterfly Bank subregions suggests that these areas may represent portions of the Bight important to both feeding and traveling whales.

Olympic Coast: The Prairie, Barkley Canyon, and Nitnat Canyon (Washington)

Potential Criterion:	2B: Foraging Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) Killer whale (*Orcinus orca*)
Proposed Boundary Consideration: Location inferred from Calambokidis et al. (2004)	125°58'38.786"W, 48°30'1.995"N to 125°38'52.052"W, 48°16'55.605"N to 125°17'10.935"W, 48°23'7.353"N to 125°16'42.339"W, 48°12'38.241"N to 125°31'14.517"W, 47°58'20.361"N to 126°6'16.322"W, 47°58'20.361"N to 126°25'48.758"W, 48°9'46.665"N *and existing OBIA boundary as defined in the 2007 Rule.*
Proposed Seasonal Consideration:	June through September

Background

- A CSCAPE survey reported that humpback whale sightings were concentrated in the northern part of the study area between Juan de Fuca Canyon and the outer edge of the continental shelf, an area known as "the Prairie" (Fig. 2). A small area east of the mouth of Barkley Canyon and north of the Nitnat Canyon where the water depth was 125−145 m had a high density of sightings in all years (Calambokidis et al., 2004). http://www.cascadiaresearch.org/reports/Fish-bul-OCSwEratum.pdf

- NOAA Technical Memorandum 406 (NMFS 2007) estimated that the abundance of humpback whales within the combined three OC strata during 2005 (208, CV=0.28) was about twice the observed abundance during 1995-2000 (range of abundance estimates: 85 - 125, CVs ~0.32), but lower than the peak year of 2002 with 562 (CV=0.21) humpback whales.

- NOAA Technical Memorandum 406 (NMFS 2007) reports that humpback whales were observed largely in the same areas of the OCNMS as during previous years and noted that regions within and to the north (Canadian waters) and west (slope waters) of the OCNMS were likely important foraging regions for West Coast humpback whales.

Gulf of Alaska Steller Sea Lion Critical Habitat (Alaska)

Potential Criterion:	2B: Designated Critical Habitat
Species of Concern:	Steller sea lion (*Eumetopias jubatus*)
Proposed Boundary Consideration: Basis: U.S. Government	Critical habitat includes an aquatic zone that extends 20 nm (37 km) seaward in State and Federally-managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is west of 144°W longitude. 145°43'7.708"W, 60°17'41.42"N to 143°37'31.682"W, 59°38'59.715"N to 146°26'15.838"W, 59°6'38.618"N to 147°34'46.397"W, 59°30'6.865"N to 150°15'53.824"W, 58°57'45.767"N to 151°45'20.388"W, 57°8'1.26"N to 155°30'50.98"W, 55°26'1.094"N to 159°22'19.342"W, 54°24'29.203"N to 162°43'58.85"W, 53°54'32.736"N to 163°23'18.616"W, 54°12'18.436"N to 172°57'38.806"W, 51°40'49.533"N to 179°25'44.364"W, 50°49'26.613"N to 179°39'3.639"W, 51°6'34.253"N to 163°49'34.33"W, 54°21'56.96"N to 157°56'22.112"W, 56°20'3.869"N to 153°11'13.812"W, 58°25'39.894"N to 148°41'53.223"W, 59°49'8.687"N to 148°2'52.488"W, 59°38'59.715"N
Proposed Seasonal Consideration:	Year-Round

Background

- NMFS has designated critical habitat for the Steller sea lion in certain areas and waters of Alaska. Steller sea lions are dependent on these areas and features for its continued existence and any Federal action that may affect these areas or features is subject to the consultation requirements of section 7 of the ESA (NMFS, 1993).
- The critical habitat surrounding each GOA rookery and major haulout site includes not only the aquatic areas adjacent to rookeries that are essential to lactating females and juveniles, but also - encompasses aquatic zones around major haulouts which provide foraging and refuge habitat for non-breeding animals year-round and for reproductively mature animals during the non-breeding season (NMFS, 1993).
- Critical habitat includes an aquatic zone that extends 3,000 feet (0.9 km) seaward in State- and Federally-managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is east of 144°W longitude. Critical habitat includes an aquatic zone that extends 20 nm (37 km) seaward in State and Federally-managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is west of 144°W longitude (NMFS, 1993).

IUCN Marine Region 16: Northwest Pacific

Piltun and Chayvo Offshore Feeding Grounds (Russia)

Potential Criteria:	2B: Migration Route 2B: Foraging Area
Species of Concern:	Western Pacific gray whale (*Eschrichtius robustus*)
Proposed Boundary Consideration: Location inferred from IWC and Tyurneva (2006)	143°33'26.5"E, 53°30'42.938"N to 143°40'42.039"E, 53°34'13.683"N to 143°48'39.728"E, 52°41'4.409"N to 143°51'56.423"E, 52°1'44.066"N to 143°24'32.613"E, 52°2'54.314"N to 143°40'13.94"E, 52°38'43.912"N to 143°33'26.5"E, 53°30'42.938"N
Proposed Seasonal Consideration:	June through November

Background

- The critically endangered western gray whale spends the summer-fall open water period feeding off northeast Sakhalin Island (Rutenko, et al., 2007).
- A previously unknown gray whale feeding area (the Offshore feeding area) was discovered south and offshore from the nearshore Piltun feeding area. The Offshore area has subsequently been shown to be used by feeding gray whales during several years when no anthropogenic activity occurred near the Piltun feeding area (Johnson, et al., 2007).
- The western population of gray whales is one of the most endangered whale populations in the world. Total abundances from 1997 to 2003 were estimated as 64 ± 5.1 (SE), 55 to 75 (95% CI); 75 ± 4.9, 66 to 85; 86 ± 3.1, 80 to 93; 77 ± 4.7, 68 to 87; 91 ± 3.4, 84 to 98; 98 ± 4.1, 90 to 106; and 99 ± 4.9, 90 to 109, respectively. These abundance estimates, particularly the last values in the series, most likely approximate the size of the entire western gray whale population. For comparison to the trend in the abundance estimates, life history data were used to estimate the growth rate of the population. Depending on the range of potential fecundity values incorporated, the resulting growth rate estimates indicate an annual population increase that is between 2.5 and 3.2%. The extremely small population size and slow rate of increase documented here further highlight concern about the viability of this critically endangered population (Bradford, et al., 2008).
- Results of a 2001-2003 aerial survey of the area indicated that gray whales occurred in predominantly two areas, (1) adjacent to Piltun Bay, and (2) offshore from Chayvo Bay (offshore feeding areas). In the Piltun feeding area, the majority of whales were observed in waters shallower than 20 m and were distributed from several hundred meters to similar to 5 km from the shoreline. In the offshore feeding area during all years, the distribution of gray whales extended from southwest to northeast in waters 30-65 m in depth. Fluctuations in the number of whales observed within the Piltun and offshore feeding areas and few sightings outside of these two areas indicate that gray whales move between the Piltun and offshore feeding areas during their summer-fall feeding season. Seasonal shifts in the distribution and abundance of gray whales between and within both the Piltun and offshore feeding areas are thought, in part, to be a response to seasonal changes in the distribution and abundance of prey (Meier, et al., 2007).

IUCN Marine Region 17: Southeast Pacific

Costa Rica Dome (Costa Rica, Panama)

Potential Criteria:	2B: Foraging Area 2B: Wintering Ground
Species of Concern:	Blue whale (*Balaenoptera musculus*) Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration:	TBD
Proposed Seasonal Consideration:	TBD

Background

- The Costa Rica Dome is an area of the coast of Costa Rica where the strong tropical thermocline reaches to within 10 meters of the sea surface. The dome measures about 150 by 300' kilometers. It is situated near lat. 9° N., long. 89° W., at the eastern end of a ridge in the topography of the thermocline along the northern boundary of the Equatorial Countercurrent. This current, the Costa Rica Coastal Current, and parts of the North Equatorial Current form a cyclonic circulation around the dome (Wyrtki, 1964).
- The distribution of blue whales, in the eastern tropical Pacific (ETP) was analyzed from 211 sightings of 355 whales recorded during research vessel sighting surveys or by biologists aboard fishing vessels. Over 90% of the sightings were made in just two areas: along Baja California, and in the vicinity of the Costa Rica Dome. All sightings occurred in relatively cool, upwelling-modified waters. The Costa Rica Dome area was occupied year round, suggesting either a resident population, or that both northern and southern hemisphere whales visit with temporal overlap (Reilly and Thayer, 1990).
- Research conducted in the 1990s reported that some humpback whales from the North Pacific were also using Costa Rican waters as a wintering ground (Acevedo and Smultea, 1995).
- With blue whales, the greatest unknown is whether their year-round residency on the Costa Rica Dome is indicative of a distinct, non-migratory population segment or whether some individuals may choose not to migrate every year (Calambokidis et al. 1990).

IUCN Marine Region 18: Australia – New Zealand

Great Barrier Reef Between 16°S and 21°S (Australia)

Potential Criterion:	2B: Breeding Ground
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) Dwarf Minke whale (*Balaenoptera acutorostrata*)
Proposed Boundary Consideration: Location inferred from Arnold (1997)	145°38'46.988"E, 16°1'49.75"S to 146°20'56.18"E, 15°52'12.917"S to 146°59'23.514"E, 17°28'21.251"S to 151°39'40.427"E, 20°16'13.65"S to 150°30'53.849"E, 20°58'22.843"S to 146°49'46.681"E, 18°51'10.893"S to 145°38'46.988"E, 16°1'49.75"S
Proposed Seasonal Consideration:	May through September

Background

- Of particular concern in the Marine Park is a population of dwarf minke whales occurring off northern Queensland, most often seen in the Ribbon Reefs area in June and July although present in the Park from about May to October (Great Barrier Reef Marine Park Authority 2000)
- Commercial swim programs with the dwarf minke whale occur seasonally (primarily June - July) within the Cairns and Far Northern sections of the Great Barrier Reef (GBR) Marine Park (Birtles et al. 2002).
- An IWC compilation of 181 sightings from the central and northern Great Barrier Reef indicated that dwarf minke whales were regularly seen between Cairns (16°55' S) and Yonge Reef (14° 36' S). Sightings occurred from May to September, with 79.5% of sightings in June and July. Observations suggest, however, that groups of animals may occur in open water on the continental shelf, inshore of the reefs where most whales have been reported. Records of stranded animals 3 m or less in length indicate calving can occur at about 24E-38E S in Australia. There were four reports of cow-calf pairs on the northern Great Barrier Reef, between 15°-16°S, but more information is needed to assess the extent to which the area is a calving/nursery ground (Arnold 1997).
- Humpback whales which migrate along the east Australian coast comprise part of the Area V (130° E - 170° W) stock. Sheltered water within the Great Barrier Reef between latitudes 16°-21° S appear to be an important breeding ground for the east Australian humpback whale stock (Paterson and Paterson, 1984).
- The humpback whales present in the marine park generally spend the summer feeding in the nutrient-rich waters of Antarctica, migrate northwards in the autumn, and winter in warm-water breeding areas, including the waters off the coast of Queensland. Humpbacks are usually present in the Marine Park from June to October. Of particular concern in the Marine Park are possible adverse effects on pregnant females and cows with young calves. Lactating females typically migrate north before pregnant females, and cows with newborn calves tend to be last to leave the breeding areas to return south to the feeding grounds. Thus, cows who are pregnant or who have young (dependent) calves are present in the Marine Park throughout the season (Great Barrier Reef Marine Park Authority 2000).

Bonney Upwelling (Australia)

Potential Criterion:	2B: Foraging Area
Species of Concern:	Blue whale (*Balaenoptera musculus*) Pygmy blue whale (*B. m. brevicauda*) New Zealand fur seal (*Arctocephalus forsteri*) Southern right whale (*Eubalaena australis*) Australian sea lion (*Neophoca cinera*)
Proposed Boundary Consideration: Location inferred from Gill (2002)	139°31'17.703"E, 37°12'20.036"S to 139°42'42.508"E, 37°37'33.815"S to 140°22'57.345"E, 38°10'36.144"S to 141°33'50.342"E, 38°44'50.558"S to 141°11'0.733"E, 39°7'4.125"S to 139°10'52.263"E, 37°28'33.179"S
Proposed Seasonal Consideration:	November through May

Background

- The Bonney Upwelling (formerly the Blue Whale aggregation) is characterized by classical upwelling plumes regularly observed along the Bonney Coast (Robe, South Australia to Portland, Victoria).
- To assess how seasonal changes in ocean productivity influenced foraging behavior, one study fitted18 lactating New Zealand fur seals with satellite transmitters and time-depth recorders (TDRs). Using temperature and depth data from TDRs, they used the presence of thermoclines as a surrogate measure of upwelling activity in continental- shelf waters. During the austral autumn, 80% of lactating fur seals foraged on the continental shelf (114 ± 44 km from the colony), in a region associated with the Bonney upwelling. In contrast, during winter months seals predominantly foraged in oceanic waters (62%), in a region associated with the Subtropical Front (460 ± 138 km from the colony). The study concluded that lactating New Zealand fur seals shift their foraging location from continental-shelf to oceanic waters in response to a seasonal decline in productivity over the continental shelf, attributed to the cessation of the Bonney upwelling (Bayliss et al. 2008).
- A localized aggregation of blue whales, which may be pygmy blue whales, occurs in southern Australian coastal waters (between 139°45' E-143°E) during summer and autumn (December-May), where they feed on coastal krill (*Nyctiphanes australis*), a species which often forms surface swarms. While the abundance of blue whales using this area is unknown, up to 32 blue whales have been sighted in individual aerial surveys. Krill appear to aggregate in response to enhanced productivity resulting from the summer-autumn wind-forced Bonney Coast upwelling along the continental shelf. During the upwelling's quiescent (winter-spring) period, blue whales appear to be absent from the region. Krill surface swarms have been associated with 48% of 261 blue whale sightings since 1998, with direct evidence of feeding observed in 36% of all sightings. Mean blue whale group size was 1.55 (SD = 0.839), with all size classes represented including claves. This seasonally predictable upwelling system is evidently a regular feeding ground for blue whales (Gill 2002).
- http://bluewhalestudy.com/home.html

Head of Bight (Australia)

Potential Criteria:	2B: Breeding Area 2B: Calving Area
Species of Concern:	Southern right whale (*Eubalaena australis*) Australian sea lion (*Neophoca cinera*)
Proposed Boundary Consideration: Location inferred from Burnell (2001) & Australian Government	130°28'17.18"E, 31°47'2.974"S 130°51'46.337"E, 31°47'2.974"S 130°51'46.337"E, 31°57'11.243"S 130°28'17.18"E, 31°57'1.105"S
Proposed Seasonal Consideration:	May through October

Background

- The Head of Bight represents the main breeding area for southern right whales in Australia (Burnell and Bryden, 1997; Burnell, 2001).
- The duration and timing of coastal residence of individually identified southern right whales at a principal aggregation area on the southern Australian coast differed markedly between females with calves and unaccompanied whales. The mean residence period of females that calved within the aggregation area was 70.9 days, with mean residence mid-points of 20 August in 1993 and 22 August in 1994. Whales have been sighted at this aggregation area from mid May to late October (approx. 160 days), although the effective calving season (95-100% of calves born) lasted only 88 days in 1993 and 96 days in 1994 (Burnell and Bryden, 1997).
- Over 350 individual southern right whales have been photographically identified at the Head of Bight, between 1991 and 1997 (Burnell, 2001). Calving occurs on average every 3 years with over 90% of females returning to the Head of Bight (Burnell, 2001)

Works Cited

Acevedo A, Smultea A. (1995) First records of humpback whales including calves at Golfo Dulce and Isla Del Coco, Costa Rica, suggesting geographical overlap of Northern and Southern Hemisphere populations. *Marine Mammal Science*, 11, 554-560.

Arnold, P., & International Whaling Comm. (1997). Occurrence of dwarf minke whales (*Balaenoptera acutorostrata*) on the Northern Great Barrier Reef, Australia. *Report of the International Whaling Commission*. 47, 419-424.

Azzellino, A., Gaspari, S., Airoldi, S., & Nani, B. (2008). Habitat use and preferences of cetaceans along the continental slope and the adjacent pelagic waters in the western Ligurian Sea. *Deep-Sea Research Part I: Oceanographic Research Papers, 55*(3), 296-323.

Baraff, L., Clapham, P., Mattila, D., & Bowman, R. (1991). Feeding behavior of a humpback whale in low-latitude waters. *Marine Mammal Science*, *7*(2), 197-202.

Baumgartner, M., Cole, T., Clapham, P., & Mate, B. (2003). North Atlantic right whale habitat in the lower Bay of Fundy and on the SW Scotian Shelf during 1999-2001. *Marine Ecology Progress Series, 264*, 137-154.

Baylis, A. M.M., B. Page, and S.D. Goldsworthy. 2008. Effect of seasonal changes in upwelling activity on the foraging locations of a wide-ranging central-place forager, the New Zealand fur seal. *Canadian Journal of Zoology*. 86(8), 774-789.

Bradford, A. L., D. W. Weller, P. R. Wade, A. M. Burdin And R. L. Brownell, Jr. (2008). Population abundance and growth rate of western gray whales *Eschrichtius robustus*. *Endangered Species Research,* 16, 1–14.

Birtles R.A., P.W. Arnold, and A. Dunstan. (2002). Commercial Swim Programs With Dwarf Minke Whales On The Northern Great Barrier Reef, Australia: Some Characteristics Of The Encounters With Management Implications. *Australian Mammalogy* 24, 23–38.

Burnell, S.R. (2001). Aspects of the reproductive biology, movements and site fidelity of right whales off Australia. *Journal of Cetacean Research and Management*. Special issue 2, 89-102.

Burnell, S.R. and M. M. Bryden. (1997). Coastal residence periods and reproductive timing in southern right whales, *Eubalaena australis*. *Journal of Zoology*. 241(4), 613-621.

Burtenshaw, J. C., Oleson, E. M., Hildebrand, J. A., McDonald, M. A., Andrew, R. K., Howe, B. M., et al. (2004). Acoustic and satellite remote sensing of blue whale seasonality and habitat in the Northeast Pacific. *Deep Sea Research (Part II, Topical Studies in Oceanography), 51*(10-11), 967-986.

Calambokidis, J., G.H. Steiger, J.C. Cubbage, K.C. Balcomb, C. Ewald, S. Kruse, R. Wells, and R. Sears. (1990). Sightings and movements of blue whales off central California 1986-8 from photo-identification of individuals. *Report of the International Whaling Commission* (Special Issue 12), 343-348.

Calambokidis, J., Steiger, G., Ellifrit, D., Troutman, B., & Bowlby, C. (2004). Distribution and abundance of humpback whales(*Megaptera novaeangliae*) and other marine mammals off the northern Washington coast. Fishery Bulletin, 102(4), 563-580.

Calambokidis, J., Steiger, G. H., Rasmussen, K., Urban, R. J., Balcomb, K. C., Guevara, P., et al. (2000). Migratory destinations of humpback whales that feed off California, Oregon and Washington. *Marine Ecology Progress Series, 192*, 295-304.

Carretta, J. V., Forney, K. A., Lowry, M. S., Barlow, J., Baker, J., Hanson, B., et al. (2008). *U.S. Pacific Marine Mammal Stock Assessments: 2008* (Report No. NOAA-TM-NMFS-SWFSC-434).

Clapham, P., & Mattila, D. (1990). Humpback whale songs as indicators of migration routes. *Marine Mammal Science*, *6*(2), 155-160.

Craig, A.S., and L.M. Herman. (2000). Habitat preferences of female humpback whales Megaptera novaeangliae in the Hawaiian Islands are associated with reproductive status. *Marine Ecology Progress Series*. 193, 209-216.

Croll, D. A., Marinovic, B., Benson, S., Chavez, F. P., Black, N., Ternullo, R., et al. (2005). From wind to whales: trophic links in a coastal upwelling system. *Marine Ecology Progress Series, 289*, 117-130.

D' Amico, A., Bergamasco, A., Zanasca, P., Carniel, S., Nacini, E., Portunato, N., et al. (2003). Qualitative correlation of marine mammals with physical and biological parameters in the Ligurian Sea. *IEEE Journal of Oceanic Engineering, 28*(1), 29-43.

Danilewicz, D., Tavares, M., Moreno, I., Ott, P., & Trigo, C. (2009). Evidence of feeding by the humpback whale (Megaptera novaeangliae) in mid-latitude waters of the western South Atlantic. *Marine Biodiversity Records, 2,* e88.

DFO. (2007). *Recovery Potential Assessment Of Northern Bottlenose Whale, Scotian Shelf Population. Science Advisory Report 2007/011*.

Fiedler, P., Reilly, S., Hewitt, R., Demer, D., Philbrick, V., Smith, S., et al. (1998). Blue whale habitat and prey in the California Channel Islands. *Deep-Sea Research Part II, 45*(8-9), 1781-1801.

Gabriele, C.M., S.H. Rickards, S.E. Yin, and A.S. Frankel. (2003). Trends in Relative Distribution, Abundance and Population Composition of Humpback Whales, *Megaptera novaeangliae*, in Kawaihae Bay, Hawai'i 1988-2003. *Final Report August 2003 for the Department of Land and Natural Resources, State of Hawai'I and the Hawaiian Islands Humpback Whale National Marine Sanctuary, National Marine Sanctuary Program, National Oceanic and Atmospheric Administration,* U.S. Department of Commerce. 37 pp.

Gill, P. C. (2002). A blue whale (*balaenoptera musculus*) feeding ground in a southern Australian coastal upwelling zone. *Journal of Cetacean Research and Management.* 4(2), 179-184.

Gilles, A., M. Scheidat, and U. Siebert. (2008). *Harbour porpoises in German waters –evaluating proposed Natura 2000 sites*. Edited by Peter G. H. Evans. Proceedings of the ECS/ASCOBANS/ACCOBAMS Workshop Selection Criteria for Marine Protected Areas for Cetaceans. pp. 76-82.

Hawaiian Islands Humpback Whale NMS. Hawaiian Islands Humpback Whale NMS - About Us. http://hawaiihumpbackwhale.noaa.gov/about/welcome.html (accessed September 14, 2009).

Hooker, S., Iverson, S., Ostrom, P., & Smith, S. (2001). Diet of northern bottlenose whales inferred from fatty-acid and stable-isotope analyses of biopsy samples. *Canadian Journal of Zoology, 79*(8), 1442-1454.

Hooker, S., Whitehead, H., & Gowans, S. (2002). Ecosystem consideration in conservation planning: energy demand of foraging bottlenose whales (Hyperoodon ampullatus) in a marine protected area. *Biological Conservation, 104*(1), 51-58.

IMO. (2007). *International Maritime Organization, Routing measures other than Traffic Separation Schemes. Ref. T2-OSS/2.7, SN.1/Circ.263,*.

Johnson, S. R., Richardson, W. J., Yazvenko, S. B., Blokhin, S. A., Gailey, G., Jenkerson, M. R., Meier, S. K., Melton, H. R., Newcomer, M. W., Perlov, A. S., Rutenko, S. A., Wuersig, B., Martin, C. R., & Egging, D. E. (2007). A western gray whale mitigation and monitoring program for a 3-D seismic survey, Sakhalin Island, Russia. *Environmental Monitoring and Assessment*. 134(1-3), 1-19.

Kahn, B. (2008). The Savu Sea of East Indonesia - SE Asia's Open Ocean Wilderness: Oceanic Cetacean Hotspot, Traditional Sperm Whaling and Indo-Pacific Marine Corridor. 2008 *Ocean Sciences Meeting: From the Watershed to the Global Ocean.* American Geophysical Union, 2000 Florida Ave., N.W. Washington, D.C., 20009 USA, 2008.

Keller, C., Ward-Geiger, L., Brooks, W., Slay, C., Taylor, C., & Zoodsma, B. (2006). North Atlantic right whale distribution in relation to sea-surface temperature in the southeastern United States calving grounds. *Marine Mammal Science, 22*(2), 426.

Kenney, R., Winn, H., & Macaulay, M. (1995). Cetaceans in the Great South Channel, 1979-1989: right whale (Eubalaena glacialis). *Continental Shelf Research, 15*(4-5), 385-414.

Kenney, R., & Wishner, K. (1995). The South Channel Ocean Productivity EXperiment. *Continental Shelf Research, 15*(4-5), 373-384.

Kraus, S., Hamilton, P., Kenney, R., Knowlton, A., & Slay, C. (2001). Reproductive parameters of the North Atlantic right whale. *Journal of Cetacean Research and Management, 2*, 231-236.

Mate, B. R., Gisiner, R., & Mobley, J. (1998). Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. *Canadian Journal of Zoology/Revue Canadien de Zoologie, 76*(5), 863-868.

Mattila, D., Clapham, P., Katona, S., & Stone, G. (1989). Population composition of humpback whales, Megaptera novaeangliae, on Silver Bank, 1984. *Canadian Journal of Zoology, 67*(2), 281-285.

Meier, S. K., S.B. Yazvenko, S.A. Blokhin, P. Wainwright, M.K. Maminov, Y.M. Yakovlev, and M.W. Newcomer. (2007). Distribution and abundance of western gray whales off northeastern Sakhalin island, Russia, 2001-2003. *Environmental Monitoring and Assessment*. 134(1-3), 107-136.

Merrick, R., & Cole, T. (2007). *Evaluation of northern right whale ship strike reduction measures in the Great South Channel of Massachusetts, NOAA Tech Memo NMFS NE 202*: National Oceanic and Atmospheric Administration.

Mobley, J., Jr., Spitz, S. and Grotefendt, R. (2001). *Abundance Of Humpback Whales In Hawaiian Waters: Results Of 1993-2000 Aerial Surveys*: Marine Mammal Research Consultants.

Mustika, P.L.K. (2006). Marine Mammals in the Savu Sea (Indonesia): Indeginous Knowledge, Threat Analysis and Management Options. Master's Thesis. http://eprints.jcu.edu.au/2064/

NMFS. (1993). *Designated Critical Habitat; Steller Sea Lion. 58 Federal Register 45269-45285, August 27, 1993.*

NMFS. (1994). *Designated Critical Habitat; Northern Right Whale. 59 Federal Register 28793-28834, June 3, 1994*.

NMS. (2009a, March 26, 2008). Cordell Bank Sanctuary: Seamounts And Banks. Retrieved September 2009, from http://www.sanctuarysimon.org/cordell/sections/seamounts/overview.php?sec=sm

NMS. (2009b, March 26, 2008). Cordell Bank Sanctuary: Marine Mammals. Retrieved September 2009, from http://www.sanctuarysimon.org/cordell/sections/marineMammals/overview.php?sec=mm

NMS. (2009c, March 26, 2008). Gulf of the Farrallones Sanctuary. Retrieved September 2009, from http://www.sanctuarysimon.org/farallones/index.php

Notarbartolo-Di-Sciara, G., Zanardelli, M., Jahoda, M., Panigada, S., & Airoldi. (2003). The fin whale Balaenoptera physalus (L. 1758) in the Mediterranean Sea. *Mammal Review, 33*(2), 105-150.

Oleson, E., Calambokidis, J., Barlow, J., & Hildebrand, J. B. (2007). Blue whale visual and acoustic encounter rates in the Southern California Bight. *Marine Mammal Science, 23*(3), 574-597.

Panigada, S., Notarbartolo di Sciara, G., Panigada, M., Airoldi, S., Borsani, J., & Jahoda, M. (2005). Fin whales (Balaenoptera physalus) summering in the Ligurian Sea: distribution, encounter rate, mean group size and relation to physiographic variables. *Journal of Cetacean Research Management*, *7*(2), 137-145.

Paterson, R., and P. Paterson. (1984). A study of the past and present status of humpback whales in east Australian waters. *Biological Conservation*. 29(4), 321-343.

Pet-Soede, L. (2002). The Solor and Alor islands: Expedition results, data collected during 2 reconnaissance trips; 9-12 September 2001 and 7-19 May, 2002. *Report of a joined activity by The Nature Conservancy Southeast Asia Center for Marine Protected Areas and World Wide Fund for Nature Wallacea Bioregional Program*. 110p.

Reeves, R., Mckenzie, M., & Smith, T. (2006). History of Bermuda shore whaling, mainly for humpback whales. *Journal of Cetacean Research and Management, 8*(1), 33.

Reilly, S., & Thayer, V. (1990). Blue Whale (Balaenoptera-Musculus) Distribution In The Eastern Tropical Pacific. *Marine Mammal Science, 6*(4), 265-277.

Rutenko, A. N., S.V. Borisov, A.V. Gritsenko, and M.R. Jenkerson. (2007). Calibrating and monitoring the western gray whale mitigation zone and estimating acoustic transmission during a 3D seismic survey, Sakhalin island, Russia. *Environmental Monitoring and Assessment*. 134(1-3), 21-44.

Scheidat, M., A. Gilles, K.-H. Kock, and U. Siebert. (2008). Harbour porpoise Phocoena phocoena abundance in the southwestern Baltic Sea. *Endangered Species Research*. 5, 215–223.

Scott, G.P., and H.E. Winn. (1977). An aerial sampling method for humpback whales, Megaptera novaeangliae, using vertical photographs. *Proceedings (abstracts) of the Second Conference on the Biology of Marine Mammals, San Diego, California, 12-15 December 1977.*

Shelden, K. E. W., Baldridge, A., & Withrow, D. E. (1995). Observations of Risso's dolphins, Grampus griseus with gray whales, Eschrichtius robustus. *Marine Mammal Science, 11*(2), 231-240.

Siebert, U., A. Gilles, K. Lucke, M. Ludwig, H. Benke, K.H. Kock, M. Scheidat. (2006). A decade of harbour porpoise occurrence in German waters: analyses of aerial surveys, incidental sightings and strandings. *Journal of Sea Research*. 56(1), 65-80.

Stone, G., Katona, S., & Tucker, E. J. B. C. (1987). History, migration and present status of humpback whales Megaptera novaeangliae at Bermuda. *42*(2), 133-145.

Tyack, P., and H. Whitehead. (1983). Male competition in large groups of wintering humpback whales. *Behaviour*. 83(1-2), 132-154.

Verfuss, U. .K, C.G. Honnef, A., Daehne, M. Meding, R. Mundry, and H. Benke. (2007). Geographical and Seasonal Variation of Harbour Porpoise (*Phocoena phocoena*) Presence in the German Baltic Sea Revealed By Passive Acoustic Monitoring. *Journal of the Marine Biological Association of the United Kingdom*. 87(1), 165-176.

Waring, G., Josephson, E., Fairfield-Walsh, C., & Maze-Foley, K. (2009). US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments--2008. *NOAA Tech Memo NMFS NE 210, 210*(440), 02543-01026.

Whitehead, H., and M., Moore. (1982). Distribution and movements of West Indian humpback whales in winter. *Canadian Journal of Zoology*. 60(9), 2203–2211.

Whitehead, H., Gowans, S., Faucher, A., & McCarrey, S. (1997). Population analysis of northern bottlenose whales in the Gully Nova Scotia. *Marine Mammal Science, 13*(2), 173-185.

Wimmer, T., & Whitehead, H. (2004). Movements and distribution of northern bottlenose whales, Hyperoodon ampullatus, on the Scotian Slope and in adjacent waters. *Canadian Journal of Zoology, 82*(11), 1782-1794.

Yen, P. P. W., Sydeman, W. J., & Hyrenbach, K. (2004). Marine bird and cetacean associations with bathymetric habitats and shallow- water topographies: implications for trophic transfer and conservation. *Journal of Marine Systems, 50*(1-2), 79-99.

APPENDIX D-3: NMFS INITIAL MARINE MAMMAL OBIA SCREENING MATRIX, 23 NOVEMBER 2009

MEDITERRANEAN

	GEOGRAPHY			BIOLOGY							CRITERIA		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Specie[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area2a, 2b, or 2	Nomination Status	Designation	IUCN Category
Northeast Slope in the Ligurian-Corsican-Provençal Basin	Mediterranean	International	Y	Fin whale	N	N	Y	N	N	N	Eligible	Eligible	Eligible	None	None
Pelagos Sanctuary for Mediterranean Marine Mammals	Mediterranean	International	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	SPAMI	N/A

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[1] Marine Region as classified by the IUCN World Commission on Protected Areas (WCPA).

[2] For Eligible OBIAs, species presence is derived from peer-reviewed literature.

NW ATLANTIC

	Geography			Biology							Eligibility		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-Op Area (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Northwest of Challenger Bank	NW Atlantic	Bermuda	Y	Humpback whale	N	N	Y	Y	N	N	Eligible	Eligible	Eligible	National Cetacean Sanctuary	None
Saguenay-St Lawrence Marine Park	NW Atlantic	Canada	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Marine Park	None
The Gully Marine Protected Area	NW Atlantic	Canada	Y	Northern bottlenose whale	N	N	Y	N	Y	Y	Eligible	Eligible	Further Analysis Necessary	MPA	None
Shortland Canyon / Haldimand Canyon	NW Atlantic	Canada	Y	Northern bottlenose whale	N	N	Y	N	Y	Y	Eligible	Eligible	Further Analysis Necessary		None
Bay of Fundy Right Whale Conservation Area	NW Atlantic	Canada	N		Y	Y	N	N	Y	N	Not Eligible	Eligible	Not Eligible	Conservation Area	None
Roseway Basin Right Whale Conservation Area (located between Browns and Baccaro Banks	NW Atlantic	Canada	Y	North Atlantic right whale	Y	N	Y	Y	N	N	Eligible	Eligible	Eligible	Proposed Conservation Area	None

NW ATLANTIC

Area	GEOGRAPHY			BIOLOGY							ELIGIBILITY		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-Op Area (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Auyuittug National Park	NW Atlantic	Canada	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Terrestrial Park	None
Manicouagan Marine Protected Area	NW Atlantic	Canada	N		N	N	Y	N	N	N	Not Eligible	Eligible	Not Eligible	Proposed MPA	None
Igaliqtuuq National Wildlife Area and Biosphere Reserve	NW Atlantic	Canada	N		N	N	Y	Y	Y	N	Not Eligible	Eligible	Not Eligible	Proposed MPA	None
Beaufort Sea Beluga Management Zone 1(a)	NW Atlantic	Canada	N		Y	N	Y	Y	Y	N	Not Eligible	Eligible	Not Eligible	Management Zone	None
Beaufort Sea Large Ocean Management Area (LOMA) (Shelf Break, Tuk Pen Inner and Outer Shelf areas)	NW Atlantic	Canada	N		Y	N	Y	Y	N	N	Not Eligible	Eligible	Not Eligible	Proposed MPA	None
Lancaster Sound National Marine Conservation Area	NW Atlantic	Canada	N		Y	N	Y	Y	Y	N	Not Eligible	Eligible	Not Eligible	Conservation Area	None

NW ATLANTIC

	Geography			Biology							Eligibility		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-Op Area (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
West Isles National Marine Conservation Area	NW Atlantic	Canada	N		N	N	N	N	Y	N	Not Eligible	Eligible	Not Eligible	Proposed Conservation Area	None
Bonavista-Notre Dame Bays National Marine Conservation Area	NW Atlantic	Canada	N		U	N	U	U	N	U	Not Eligible	Unknown	Not Eligible	Proposed Conservation Area	None
Gerry E Studds Stellwagen Bank National Marine Sanctuary	NW Atlantic	United States	N	North Atlantic right whale	Y	N	Y	Y	N	N	Not Eligible	Not Eligible	Not Eligible	MPA	None
Great South Channel Northern Right Whale Seasonal Habitat	NW Atlantic	United States	Y	North Atlantic right whale	Y	N	Y	N	Y	N	Eligible	Eligible	Eligible	Federal ES Protected Area	IV
Cape Cod Bay Northern Right Whale Critical Habitat Area	NW Atlantic	United States	N		Y	N	Y	Y	Y	N	Not Eligible	Eligible	Not Eligible	Federal ES Protected Area	IV
Cape Cod Bay Ocean Sanctuary	NW Atlantic	United States	N		Y	N	Y	Y	N	N	Not Eligible	Eligible	Not Eligible	State Ocean Sanctuary	V

NW ATLANTIC

	Geography			Biology							Eligibility		Preliminary Result	Additional Information	
Area	**Marine Region[1]**	**Country**	**Outside the Coastal Standoff Distance or Non-Op Area (1)**	**Species[2]**	**High Density (2a)**	**Breeding Calving (2b)**	**Foraging Grounds (2b)**	**Migration Route (2b)**	**Critical Habitat (2b)**	**Small, Distinct Population (2c)**	**Criterion 1: Coastal Standoff Distance**	**Criterion 2: Concentration Area 2a, 2b, or 2c**	**Nomination Status**	**Designation**	**IUCN Category**
Cape Cod Ocean Sanctuary	NW Atlantic	United States	N		Y	N	Y	Y	N	N	Not Eligible	Eligible	Not Eligible	State Ocean Sanctuary	V
Monitor National Marine Sanctuary	NW Atlantic	United States	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	MPA	None
Jeffreys Ledge (proposed MPA or proposed extension to Stellwagen Bank NMS)	NW Atlantic	United States	N		Y	N	Y	Y	Y	N	Not Eligible	Eligible	Not Eligible	Proposed MPA	None

NE ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Wadden Sea (Waddensee) Nature Reserve	NE Atlantic	Denmark, Germany, Netherlands	N		N	N	N	U	Y	Y	Not Eligible	Unknown	Not Eligible	International Reserve	None
Celtic Shelf Break Marine Protected Area	NE Atlantic	France, Ireland, France	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Proposed Offshore MPA	None
Dogger Bank Special Area of Conservation	NE Atlantic	Denmark, Germany, Netherlands, United Kingdom	Y	Harbor porpoise	Y	N	N	N	N	N	Eligible	Eligible	Further Analysis Necessary	Proposed SAC	None
Ilhéu de Baixo - Restinga Ilha Graciosa ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Costa e Caldeirão - Ilha do Corvo ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Caldeira e Capelinhos - Ilha do Faial ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Monte da Guia - Ilha do Faial ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None

NE ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Morro de Castelo Branco - Ilha do Faial ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Costa Nordeste - Ilha das Flores ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Ponta dos Rosais - lha de S Jorge ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Costa NE e Ponta do Topo - Ilha de S Jorge ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Caloura-Ponta da Galera - Ilha de S Miguel ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Banco D João de Castro (Canal Terceira - S Miguel) ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Baixa do Sul (Canal do Faial) ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None

NE ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Ponta da Ilha - Ilha do Pico ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Lajes do Pico - Ilha do Pico ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Ilhéus da Madalena - Ilha do Pico ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Ponta do Castelo - Ilha de Sta Maria ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Costa das Quatro Ribeiras - Ilha da Terceira ZEC	NE Atlantic	Portugal (Azores)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Formigas Islets and Dollabarat Reef (Canal S Miguel-Sta Maria) Nature Reserve (Seamount)	NE Atlantic	Portugal (Azores)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve & Proposed MPA	None
Iroise Marine National Park	NE Atlantic	France	N		N	Y	N	N	Y	N	Not Eligible	Eligible	Not Eligible	Nature Reserve	None

NE ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Harbor Porpoise Sanctuary and SAC, National Park Wadden Sea of Schleswig-Holstein (Sylt Outer Reef)	NE Atlantic	Germany	Y	Harbor porpoise	Y	Y	Y	N	N	N	Eligible	Eligible	Further Analysis Necessary	Proposed SAC	None
Harbor Porpoise Sanctuary and SAC, National Park Wadden Sea of Schleswig-Holstein (Borkum-Riffgrund)	NE Atlantic	Germany	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Proposed SAC	None
Eastern German Bight	NE Atlantic	Germany	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible		None
Schleswig-Holsteinishes Wattenmeer National Park	NE Atlantic	Germany	N		Y	Y	N	Y	N	Y	Not Eligible	Eligible	Not Eligible	National Park & Proposed SAC	II

NE ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Irish Whale and Dolphin Sanctuary (Coast to EEZ limit)	NE Atlantic	Ireland	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	National Sanctuary	None
Shannon River Estuary SAC	NE Atlantic	Ireland	N		U	Y	Y	N	U	Y	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Galway Bay SAC	NE Atlantic	Ireland	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
North Connemara SAC	NE Atlantic	Ireland	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Roaringwater Bay SAC	NE Atlantic	Ireland	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Blasket Islands SAC	NE Atlantic	Ireland	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Dublin Bay SAC	NE Atlantic	Ireland	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Dursey Island SAC	NE Atlantic	Ireland	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Old Head of Kinsale SAC	NE Atlantic	Ireland	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Madeiran Marine Mammal Sanctuary	NE Atlantic	Portugal (Maderia)	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	National Sanctuary	None

NE ATLANTIC

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Ilhas Desertas Natural Reserve and ZEC	NE Atlantic	Portugal (Maderia)	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Ponta de S. Lourenço ZEC	NE Atlantic	Portugal (Maderia)	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Ilhéu da Viúva Natural Reserve and ZEC	NE Atlantic	Portugal (Maderia)	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Sado Estuary Natural Reserve and Ramsar area	NE Atlantic	Portugal	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Arrábida Natural Park and Marine Natural Reserve	NE Atlantic	Portugal	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Marine Natural Reserve & Proposed SAC	None
Doñana National Park	NE Atlantic	Spain	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park & Proposed SAC	None
Breña y Marismas de Barbate Natural Park	NE Atlantic	Spain	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Park & Proposed SAC	V

NE ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Islas Cies and Complex Ons-Ogrove National Park	NE Atlantic	Spain	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Park & Proposed SAC	V
Moray Firth	NE Atlantic	United Kingdom	N		U	U	U	U	U	N	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Cardigan Bay SAC	NE Atlantic	United Kingdom	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	SAC	None
Lleyn Peninsula and the Sarnau SAC	NE Atlantic	United Kingdom	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed SAC	None
Hebridean Marine National Park	NE Atlantic	United Kingdom	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park & Proposed MPA	None
Atlantic Frontier MPA and World Heritage Site	NE Atlantic	United Kingdom	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Proposed Offshore MPA	None
St Kilda Archipelago	NE Atlantic	United Kingdom	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	World Heritage Site & Proposed SAC	None

BALTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Fehmarnbelt (Fehmarn Belt)	Baltic	Germany	N		N	Y	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Kadetrinne (Kadet Trench)	Baltic	Germany	N		Y	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Proposed SAC	None
Westliche Rönnebank (Western Ronne Bank)	Baltic	Germany	Y	Harbor porpoise	N	N	N	N	N	Y	Eligible	Eligible	Further Analysis Necessary	Proposed SAC	None
Pommersche Bucht mit Oderbank (Pommeranian Bay Odra Bank)	Baltic	Germany	Y	Harbor porpoise	N	N	N	N	N	Y	Eligible	Eligible	Further Analysis Necessary	Proposed SAC	None
Adlerground (Adler Ground)	Baltic	Germany	Y	Harbor porpoise	N	N	N	N	N	Y	Eligible	Eligible	Further Analysis Necessary	SAC	None
Kurshskaya Kosa National Park	Baltic	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Coastal National Park	None

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CARIBBEAN

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Pelican Cays Land and Sea Park	Caribbean	Bahamas	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	II
Exuma Cays Land and Sea Park	Caribbean	Bahamas	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	II
Inagua National Park	Caribbean	Bahamas	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	II
Abaco National Park	Caribbean	Bahamas	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	II
Central Andros National Parks	Caribbean	Bahamas	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	None
Little Inagua National Park	Caribbean	Bahamas	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	None
Moriah Harbour Cay National Park	Caribbean	Bahamas	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	None
Port Honduras Marine Reserve	Caribbean	Belize	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Marine Reserve	IV
Belize Barrier Reef Reserve System World Heritage Site	Caribbean	Belize	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	World Heritage Site	II, III, IV

CARIBBEAN

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Swallow Cay Wildlife Sanctuary	Caribbean	Belize	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Wildlife Sanctuary	IV
Turneffe Atoll MPA and Biosphere Reserve	Caribbean	Belize	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Proposed Biosphere Reserve	None
Tortuguero National Park	Caribbean	Costa Rica	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	II
Gondoca-Manzanillo Wildlife Reserve	Caribbean	Costa Rica	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Wildlife Refuge	None
Seaflower Marine Protected Area	Caribbean	Columbia	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	MPA	None
Cuban National Natural Parks (19 sites)	Caribbean	Cuba	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Proposed National Parks	None
Soufrière/Scotts Head Marine Reserve	Caribbean	Dominica	N		N	N	N	Y	N	N	Not Eligible	Eligible	Not Eligible	Designated Marine Reserve	V
Marine Mammal Sanctuary of the Dominican Republic	Caribbean	Dominican Republic	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Marine Mammal Sanctuary	None

CARIBBEAN

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Silver Bank and Navidad Bank	Caribbean	Dominican Republic	Y	Humpback whale	N	Y	Y	N	N	N	Eligible	Eligible	Eligible		
East National Park	Caribbean	Domincan Republic	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park	None
Bayahibe Marine Sanctuary	Caribbean	Domincan Republic	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Sanctuary	None
French West Indies AGOA marine mammal sanctuary	Caribbean	Guadeloupe Martinique	N		Y	Y	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Proposed MPA	None
St-Barthélemy MPA	Caribbean	Guadeloupe	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Nature Reserve	IV
Montego Bay Marine Park	Caribbean	Jamaica	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Park	II
Miskito Coast Protected Area	Caribbean	Nicaragua	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Reserve	Ia
Soufrière Marine Management Area	Caribbean	St. Lucia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Management Area	VI
Princess Alexandra Marine National Park	Caribbean	Turks and Caicos Islands	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Management Area	VI

CARIBBEAN

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Mouchoir Bank Marine Sanctuary	Caribbean	Turks and Caicos Islands	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Proposed MPA	None
Gray's Reef National Marine Sanctuary and Biosphere Reserve	Caribbean	United States	N		N	Y	N	Y	N	N	Not Eligible	Eligible	Not Eligible	NMS and Biosphere Reserve	IV
Southeastern Right Whale Seasonal Habitat	Caribbean	United States	Y	North Atlantic right whale	N	Y	N	Y	Y	N	Eligible	Eligible	Eligible	Designated Critical Habitat	None
Florida Keys National Marine Sanctuary	Caribbean	United States	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	NMS	IV
Sistema Arrecifal Veracruzano	Caribbean	Mexico	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park	II
Fort Clinch State Park Aquatic Preserve	Caribbean	United States	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	State Park	None
Flower Garden Banks National Marine Sanctuary	Caribbean	United States	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	NMS	None
Caño Guaritico Wildlife Refuge	Caribbean	Venezuela	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Inland Wildlife Refuge	IV
Delta del Orinoco	Caribbean	Venezuela	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Biosphere Reserve	VI

CARIBBEAN

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Venezuelan Cetacean Sanctuary	Caribbean	Venezuela	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed Sanctuary	None

WEST AFRICA

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Caving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Canary Islands Cetacean Marine Sanctuary	West Africa	Canary Islands (Spain)	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Proposed Cetacean Sanctuary	None
Chinijo Archipelago Natural Park	West Africa	Canary Islands (Spain)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Natural Park	None
Natural Marine Park of the Whales and Franja Marina Teno Rasca SAC	West Africa	Canary Islands (Spain)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	SAC	None
Franja Marina Santiago - Valle Gran Rey SAC	West Africa	Canary Islands (Spain)	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	SAC	None
Sebadales de La Graciosa SAC	West Africa	Canary Islands (Spain)	N		N	N	N	N	Y	N	Not Eligible	Eligible	Not Eligible	Marine Reserve SAC	None
Mar de las Calmas SAC	West Africa	Canary Islands (Spain)	N		N	N	N	N	N	U	Not Eligible	Unknown	Not Eligible	Marine Reserve SAC	None
Sebadales de Corralejo SAC	West Africa	Canary Islands (Spain)	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	SAC	None

WEST AFRICA

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Caving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Área Marina de la Isleta SAC	West Africa	Canary Islands (Spain)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	SAC	None
Franja Marina de Mogán SAC	West Africa	Canary Islands (Spain)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	SAC	None
Bahía del Confital	West Africa	Canary Islands (Spain)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	SAC	None
Sebadales de Playa del Inglés	West Africa	Canary Islands (Spain)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	SAC	None
Franja Marina de Fuencaliente	West Africa	Canary Islands (Spain)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	SAC	None
Playa de Sotavento de Jandía	West Africa	Canary Islands (Spain)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	SAC	None
Southeastern Fuerteventura	West Africa	Canary Islands (Spain)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	SAC	None
Cape Verde Humpback Whale MPA	West Africa	Cape Verde	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed MPA	None
Niumi National Park	West Africa	The Gambia	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	National Park	II

WEST AFRICA

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Caving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Tanji Bird Reserve	West Africa	The Gambia	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	National Park	II
Kiang West National Park	West Africa	The Gambia	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	II
Konkoure Estuary MPA	West Africa	Guinea	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	Wetland of International Importance	None
Banc d'Arguin National Park and Biosphere Reserve	West Africa	Mauritania	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	National Park	II
Dakhla National Park	West Africa	Morocco	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	National Park	None
Saloum Delta National Park and Siné-Saloum Biosphere Reserve	West Africa	Senegal	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	National Park	II
De Hoop MPA	West Africa	South Africa	N		N	N	N	N	N	Y	Not Eligible	Eligible	Not Eligible	MPA	IV
Robberg MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Dwesa-Cwebe MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Tsitsikamma MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV

WEST AFRICA

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Caving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Sardinia Bay MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Mkambati MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Hluleka MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Trafalgar MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
St Lucia MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Maputaland MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Helderberg MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Walker Bay Whale Sanctuary	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
West Coast National Park	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park	None
Langebaan Lagoon	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Sixteen Mile Beach	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Marcus Island	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV

WEST AFRICA

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Caving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Jutten Island	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Malgas Island	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Cape Peninsula and Castle Rock	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park Proposed MPA	None
Betty's Bay MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
Goukamma MPA	West Africa	South Africa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	MPA	IV
St Helena Biosphere Reserve	West Africa	British Overseas Territory	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed Biosphere	None
Tristan da Cunha Cetacean Sanctuary (Coast to EEZ limit)	West Africa	British Overseas Territory	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Cetacean Sanctuary	None
Inaccessible Island Nature Reserve	West Africa	British Overseas Territory	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	None
Gough Island Wildlife Reserve	West Africa	British Overseas Territory	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	Ia

SOUTH ATLANTIC

Area[1]	Geography			Biology							Criteria		Preliminary Result	Additional Information	
	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Bahía Anegada Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	None
Golfo San José Provincial Marine Park	South Atlantic	Argentina	N		U	Y	U	U	Y	Y	Not Eligible	Unknown	Not Eligible	Marine Park	II
Punta Loma Faunal Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Faunal Reserve	None
Punta Norte Provincial Faunal Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Faunal Reserve	None
Punta Pirámide Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	None
Península Valdés Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	None
Bahía San Antonio Oeste Hemispheric Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Reserve	None
Bahía Laura Provincial Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	IV

SOUTH ATLANTIC

Area[1]	Geography: Marine Region[1]	Geography: Country	Geography: Outside the Coastal Standoff Distance or Non-OpArea (1)	Biology: Species[2]	Biology: High Density (2a)	Biology: Breeding Calving (2b)	Biology: Foraging Grounds (2b)	Biology: Migration Route (2b)	Biology: Critical Habitat (2b)	Biology: Small, Distinct Population (2c)	Criteria: Criterion 1: Coastal Standoff Distance	Criteria: Criterion 2: Concentration Area 2a, 2b, or 2c	Preliminary Result: Nomination Status	Additional Information: Designation	Additional Information: IUCN Category
Cabo Blanco Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	IV
Monte Loayza Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	None
Península San Julián and Bahía de San Julián Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Provincial Reserve	IV
Complejo Bahía Oso Marino Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	None
Ría Deseado Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Provincial Reserve	VI
Costa Atlántica de Tierra del Fuego Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park	II
Tierra del Fuego National Park and National Strict Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park	II

SOUTH ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area[1]	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Isla Monte León Provincial Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Provincial Reserve	None
Cabo Virgenes Nature Reserve	South Atlantic	Argentina	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Provincial Reserve	IV
Cabo Orange National Park	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park	II
Lago Piratuba Biological Reserve	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Biological Reserve	None
Mamirauá Sustainable Development Reserve	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Development Reserve	None
Amanã Sustainable Development Reserve	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Development Reserve	None
Atol das Rocas Biological Reserve	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Biological Reserve	Ia
Fernando de Noronha National Marine Park	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park	II

SOUTH ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area[1]	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Abrolhos National Marine Park	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park	II
Shelf of the Northern Coast Environmental Protected Area	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Unknown	None
Arraial do Cabo Sustainable Reserve	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Sustainable Reserve	None
Laje de Santos Marine State Park (18 nm offshore, small rocky feature)	South Atlantic	Brazil	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	State Marine Park	II
Tupiniquins Ecological Station	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Ecological Station	Ia
Tupinambás Ecological Station	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Ecological Station	Ia
Ilhabela State Marine Park	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	State Park	II

SOUTH ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area[1]	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Ilha Anchieta State Marine Park	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	State Park	II
Anhatomirim Environmental Protection Area	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Environmental Protection Area	None
Right Whale Environmental Protection Area	South Atlantic	Brazil	N		U	U	U	Y	U	Y	Not Eligible	Unknown	Not Eligible	Environmental Protection Area	None
Marine Tucuxi Environmental Protection Area of Paraty Bay	South Atlantic	Brazil	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Environmental Protection Area	None
Falkland Islands Marine Mammal Sanctuary (Coast to EEZ limit)	South Atlantic	United Kingdom	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Marine Mammal Sanctuary	None
Punta Ballena - Bahía de Maldonado - José Ignacio MPA	South Atlantic	Uruguay	N		U	U	U	U	Y	U	Not Eligible	Unknown	Not Eligible	Proposed Biosphere Reserve	None

SOUTH ATLANTIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area[1]	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Cabo Santa María - La Pedrera MPA	South Atlantic	Uruguay	N		U	U	U	U	Y	U	Not Eligible	Unknown	Not Eligible	Proposed Biosphere Reserve	None
Cabo Polonio - Punta del Diablo MPA	South Atlantic	Uruguay	N		U	U	U	U	Y	U	Not Eligible	Unknown	Not Eligible	Proposed Biosphere Reserve	None

INDIAN

Area	Geography: Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Biology: Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criteria: Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Preliminary Result: Nomination Status	Additional Information: Designation	IUCN Category
Sundarbans World Heritage Site	Central Indian Ocean	Bangladesh	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Wildlife Sanctuary	IV
Sangu River	Central Indian Ocean	Bangladesh	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Proposed Sanctuary	None
National Chambal Sanctuary	Central Indian Ocean	India	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Sanctuary	None
Vikramshila Gangetic Dolphin Sanctuary	Central Indian Ocean	India	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Sanctuary	None
Gulf of Mannar Marine National Park	Central Indian Ocean	India	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Marine National Park	Ib
Eidhigali Kulhi / Koattey Protected Area	Central Indian Ocean	Maldives	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed Designation	None

INDIAN

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Lampi Island Marine National Park	Central Indian Ocean	Myanmar	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park	Ib
Royal Bardia National Park	Central Indian Ocean	Nepal	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park	None
Palk Bay and the Gulf of Mannar Marine International Park	Central Indian Ocean	Sri Lanka	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park	None

ARABIAN SEAS

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Daymaniyat Islands National Nature Reserve	Arabian Seas	Oman	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Nature Reserve	IV
Bar al Hikman	Arabian Seas	Oman	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed MPA	None
Masirah Island	Arabian Seas	Oman	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed MPA	None
Indus River Dolphin Reserve, or Sind Dolphin Reserve	Arabian Seas	Pakistan	N		U	U	U	U	U	Y	Not Eligible	Unknown	Not Eligible	Reserve	None

EAST AFRICA

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Mohéli Marine Park	East African	Comoros	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Park	II
Malindi Marine National Park and Reserve	East African	Kenya	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park	II
Watamu Marine National Park and Reserve	East African	Kenya	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park	II
Mombasa Marine National Park and Reserve	East African	Kenya	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park	II
Diani-Chale Marine National Reserve	East African	Kenya	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park	VI
Kisite Marine National Park and Mpunguti Reserve	East African	Kenya	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Park	II
Kiunga Marine National Reserve	East African	Kenya	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine National Reserve	VI

EAST AFRICA

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Manannara North Biosphere Reserve, Antafana Islands Marine Park	East African	Madagascar	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Park	II
Masoala National Park, including Itampolo, Masoala and Tanjona Reserves	East African	Madagascar	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Park	II, VI
Baie d'Antongil - Sainte Marie Island Humpback Whale Sanctuary	East African	Madagascar	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Proposed MPA	None
Toliara-Nosy Ve Candidate World Heritage Site	East African	Madagascar	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Candidate World Heritage Site	None
Passe en S Reserve (Passe de Longogori)	East African	Mayotte (France)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Strict Fishing Reserve	VI

EAST AFRICA

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	**Marine Region[1]**	**Country**	**Outside the Coastal Standoff Distance or Non-OpArea (1)**	**Species[2]**	**High Density (2a)**	**Breeding Calving (2b)**	**Foraging Grounds (2b)**	**Migration Route (2b)**	**Critical Habitat (2b)**	**Small, Distinct Population (2c)**	**Criterion 1: Coastal Standoff Distance**	**Criterion 2: Concentration Area 2a, 2b, or 2c**	**Nomination Status**	**Designation**	**IUCN Category**
Saziley Reserve	East African	Mayotte (France)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Park	II
Bazaruto Archipelago National Park	East African	Mozambique	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	National Park	II
Maputo Bay-Inhaca Island Machangalo Candidate World Heritage Site	East African	Mozambique	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Faunal Reserve	VI
Zambezi River Delta Candidate World Heritage Site	East African	Mozambique	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	NA	None
Réunion Marine Park	East African	La Reunion	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	NA	None
Seychelles Marine Mammal Sanctuary (Coast to EEZ limit)	East African	Seychelles	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Marine Mammal Sanctuary	None
Menai Bay Conservation Area	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Conservation Area	VI

EAST AFRICA

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Misali Island Conservation Area	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Conservation Area	VI
Mnazi Bay-Ruvuma Estuary	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Park	VI
Mafia Island	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Park	VI
Dar es Salaam Marine Reserves (Mbudya, Bongoyo, Pangavini, Fungu Yasini)	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Reserves	None
Maziwi Marine Reserve	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Reserves	II
Mnemba Island Marine Conservation Area	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Conservation Area	VI
Chumbe Marine Sanctuary	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

EAST AFRICA

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Mkwaja Saadani National Park	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Pangani MPA	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Tanga Coral Gardens Marine Reserve and Marine Conservation Area (proposed)	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Kipumbwi Marine Conservation Area (proposed)	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Kigombe Marine Conservation Area (proposed)	East African	Tanzania	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

EAST ASIAN

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Spratly Islands Marine Sanctuary (Proposed)	East Asian	International Disputed	Y		N	N	N	N	N	N	Eligible	Not eligible	Not Eligible	NA	None
Mekong River Ramsar Site	East Asian	Cambodia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Savu Sea Marine National Park (Coast to EEZ limit)	East Asian	Indonesia	N		N	N	Y	N	N	N	Not eligible	Eligible	Not Eligible	Marine Park	None
Area in the Ombai Strait in the Savu Sea Marine National Park	East Asian	Indonesia	Y	Blue whale, sperm whale; fin whale	N	N	Y	Y	N	N	Eligible	Eligible	Eligible	Marine Park	None
Bunaken National Marine Park	East Asian	Indonesia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Wakatobi Marine National Park	East Asian	Indonesia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Cendrawasih Bay Marine National Park	East Asian	Indonesia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		

EAST ASIAN

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Komodo National Park, Biosphere Reserve and World Heritage Site	East Asian	Indonesia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Semayang Lake National Park	East Asian	Indonesia	N		U	U	U	U	U	Y	Not eligible	Unknown	Not Eligible		
Alor-Solor (Nusa Tenggara) Included within Savu Sea MPA	East Asian	Indonesia	N		N	N	Y	Y	N	N	Not eligible	Eligible	Not Eligible	Proposed MPA	
Bandanaira, Gunungapi, Lucipara, Pulau Manuk, Sangihe Talaud, Taka bone Rate, Pulau Kakabia, Kepulauan Asia, Pulau Mapia, Bali-Lombok Strait	East Asian	Indonesia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		

EAST ASIAN

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Community Fisheries Conservation Zones (FCZ) of Muang-Khong District	East Asian	Laos	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Johore Marine Park	East Asian	Malaysia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Langkawi Island Marine Park	East Asian	Malaysia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Labuan Island Marine Park	East Asian	Malaysia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
North Borneo Marine Park	East Asian	Malaysia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Lawas Marine Park	East Asian	Malaysia	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Malampaya Sound Protected Land and Seascape	East Asian	Philippines	N		U	U	U	U	U	Y	Not eligible	Unknown	Not Eligible		
Tañon Strait Protected Seascape	East Asian	Philippines	N		N	N	N	Y	N	N	Not eligible	Eligible	Not Eligible	Protected Landscape/ Seascape	V

EAST ASIAN

Area	Geography: Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Biology: Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criteria: Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Preliminary Result: Nomination Status	Additional Information: Designation	IUCN Category
Pamilacan Island Marine Mammal Sanctuary	East Asian	Philippines	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Tubbataha National Marine Park	East Asian	Philippines	Y		N	N	N	N	N	N	Eligible	Not eligible	Not Eligible	National Marine Park	II
Batanes Islands Protected Land and Seascape	East Asian	Philippines	N		N	Y	N	Y	N	Y	Not eligible	Eligible	Not Eligible		
Calayan Island Protected Area	East Asian	Philippines	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Sierra Madre Natural Park	East Asian	Philippines	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Turtle Islands Wildlife Sanctuary	East Asian	Philippines	Y		N	N	N	N	N	N	Eligible	Not eligible	Not Eligible		
Siargao Island Protected Land and Seascape	East Asian	Philippines	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Apo Reef Natural Park	East Asian	Philippines	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		
Hon Mun MPA	East Asian	Vietnam	N		U	U	U	U	U	U	Not eligible	Unknown	Not Eligible		

EAST ASIAN

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Offshore Hainan Island*	East Asian	Philippines	N	Western Pacific gray whale	N	Y	N	N	N	Y	Not eligible	Eligible	Not Eligible	None	None
Offshore Babuyan Islands*	East Asian	China	N	Humpback whale	N	Y	N	N	N	Y	Not eligible	Eligible	Not Eligible	None	None

* Although there are data to support that this general area meets Criterion 2, the preliminary analysis did not include any information that indicates that any part of the biologically important area falls outside of the Navy's 12-nm standoff zone.

SOUTH PACIFIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
American Samoa Whale and Turtle Sanctuary	South Pacific	American Samoa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Fagatele Bay National Marine Sanctuary	South Pacific	American Samoa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
National Park of American Samoa	South Pacific	American Samoa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Rose Atoll Marine National Monument	South Pacific	American Samoa	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Marine National Monument	Ia
Cook Islands Whale Sanctuary*	South Pacific	New Zealand	N		N	Y	N	Y	Y	N	Not Eligible	Eligible	Not Eligible		
Parques Marinos de Rapa Nui	South Pacific	Easter Island (Chile)	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Fiji Whale Sanctuary	South Pacific	Fiji	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Whale Sanctuary	None
French Polynesia Marine Mammal Sanctuary	South Pacific	French Polynesia	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Marine Mammal Sanctuary	None

SOUTH PACIFIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Hawaiian Islands Humpback Whale National Marine Sanctuary (Penguin Bank)	South Pacific	United States	Y	Humpback whale	N	Y	N	N	Y	Y	Eligible	Eligible	Eligible	National Marine Sanctuary	IV
New Caledonia Whale Sanctuary*	South Pacific	New Caledonia (France)	N		N	Y	N	N	Y	N	Not Eligible	Eligible	Not Eligible	Whale Sanctuary	None
Niue Whale Sanctuary	South Pacific	Niue (New Zealand)	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Whale Sanctuary	
Northwestern Hawaiian Islands Marine National Monument*	South Pacific	United States	N		N	Y	N	N	Y	N	Not Eligible	Eligible	Not Eligible	Marine National Monument	II
Area Around Nihoa, Necker, and Lisianski Islands, Gardner Pinnacles & Maro Reef (Northwestern Hawaii)*	South Pacific	United States	N	Humpback whale , short-finned pilot whale, Hawaiian monk seal, pygmy killer whale	N	Y	N	N	Y	N	Not Eligible	Eligible	Not Eligible		
Rock Islands Conservation Area	South Pacific	Palau	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

SOUTH PACIFIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Ngeremendu Bay Conservation Area	South Pacific	Palau	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Pacific Remote Islands Mairine National Monument (Palmyra Atoll, Kingman Reef)	South Pacific	United States	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Marine National Monument	II
Papua New Guinea Whale Sanctuary	South Pacific	Papua New Guinea	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Whale Sanctuary	
Milne Bay MPA	South Pacific	Papua New Guinea	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Samoa Whale, Turtle and Shark Sanctuary	South Pacific	Samoa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Aleipata MPA	South Pacific	Samoa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Safata MPA	South Pacific	Samoa	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Marovo Lagoon World Heritage Area	South Pacific	Solomon Islands	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

SOUTH PACIFIC

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Arnavon Islands Marine Conservation Area	South Pacific	Solomon Islands	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Marine Conservation Area	IV
Tongan Whale Sanctuary	South Pacific	Tonga	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Whale Sanctuary	None
Ha'apai Marine Conservation Area*	South Pacific	Tonga	N		N	N	N	Y	N	N	Not Eligible	Eligible	Not Eligible		
Funufuti Conservation Area	South Pacific	Tuvalu	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Vanuatu Marine Mammal Sanctuary	South Pacific	Vanuatu	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Whale Sanctuary	None

NORTHEAST PACIFIC

Area	Geography: Marine Region[1]	Geography: Country	Geography: Outside the Coastal Standoff Distance or Non-OpArea (1)	Biology: Species[2]	Biology: High Density (2a)	Biology: Breeding Calving (2b)	Biology: Foraging Grounds (2b)	Biology: Migration Route (2b)	Biology: Critical Habitat (2b)	Biology: Small, Distinct Population (2c)	Criteria: Criterion 1: Coastal Standoff Distance	Criteria: Criterion 2: Concentration Area 2a, 2b, or 2c	Preliminary Result: Nomination Status	Additional Information: Designation	Additional Information: IUCN Category
Orca Pass International Marine Stewardship Area	Northeast Pacific	International	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Robson Bight/Michael Bigg Ecological Reserve	Northeast Pacific	Canada	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Gwaii Haanas National Marine Conservation Area Reserve	Northeast Pacific	Canada	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Race Rocks (Candidate Marine Protected Area)	Northeast Pacific	Canada	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Pacific Rim National Park Reserve	Northeast Pacific	Canada	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Southern Strait of Georgia National Marine Conservation Area	Northeast Pacific	Canada	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Scott Islands Marine Wildlife Area	Northeast Pacific	Canada	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

NORTHEAST PACIFIC

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Bowie Seamount	Northeast Pacific	Canada	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Proposed Marine Protected Area	None
Gabriola Passage	Northeast Pacific	Canada	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Clayoquot Sound Biosphere Reserve	Northeast Pacific	Canada	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Mexican Whale Refuge (Coast to EEZ limit)	Northeast Pacific	Mexico	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible	Whale Refuge	None
El Vizcaino Biosphere Reserve	Northeast Pacific	Mexico	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Revillagigedo Archipelago Biosphere Reserve	Northeast Pacific	Mexico	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Islas Marías Biosphere Reserve	Northeast Pacific	Mexico	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Loreto Bay National Park	Northeast Pacific	Mexico	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

NORTHEAST PACIFIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Upper Gulf of California and Colorado River Delta Biosphere Reserve	Northeast Pacific	Mexico	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Biosphere Reserve	Ia
Bahía Magdalena National Gray Whale Refuge	Northeast Pacific	Mexico	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Monterey Bay Submarine Canyon	Northeast Pacific	United States	Y	Blue whale pacific gray whale Steller sea lion	N	N	Y	Y	N	N	Eligible	Eligible	Eligible		
Cordell Bank Seamount	Northeast Pacific	United States	Y	Humpback whale pacific gray whale pacific white-sided dolphin	N	N	Y	Y	N	N	Eligible	Eligible	Eligible		
Area Southwest of Farrallon Islands	Northeast Pacific	United States	Y	Humpback whale pacific gray whale blue whale pacific white-sided dolphin, Steller sea lion	N	Y	N	Y	N	N	Eligible	Eligible	Eligible		
Southern California Bight: Tanner Bank and Cortez Bank	Northeast Pacific	United States	Y	Pacific gray whale blue whale fin whale Steller sea lion	N	Y	Y	Y	N	N	Eligible	Eligible	Eligible		

NORTHEAST PACIFIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Olympic Coast NMS: Including the Prairie, Barkley Canyon, and Nitnat Canyon areas	Northeast Pacific	United States	Y	Humpback whale killer whale	N	N	Y	N	N	N	Eligible	Eligible	Eligible		
Glacier Bay National Park and Preserve	Northeast Pacific	United States	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Southeastern Bering Sea Right Whale Critical Habitat (Proposed)	Northeast Pacific	United States	N		N	N	N	N	Y	N	Not Eligible	Eligible	Not Eligible	Whale Critical Habitat	None
San Juan Islands National Wildlife Refuge	Northeast Pacific	United States	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Northwest Straits Management Area	Northeast Pacific	United States	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Gulf of Alaska Steller Sea Lion Critical Habitat	Northeast Pacific	United States	Y	Steller sea lion	Y	Y	N	N	Y	N	Eligible	Eligible	Eligible		

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NORTHWEST PACIFIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Lung Kwu Chau and Sha Chau Marine Park	Northwest Pacific	China	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Xiamen Marine National Park and Conservation Areas	Northwest Pacific	China	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Baiji Natural Reserve (and the Shishou and Tong Ling semi-natural reserves)	Northwest Pacific	China	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Zhujiang (Pearl River) Delta Ecosystem Protected Area	Northwest Pacific	China	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Seto-naikai National Park	Northwest Pacific	Japan	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Finless Porpoise Gathering Area National Natural Monument	Northwest Pacific	Japan	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Botchinskiy Nature Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Commander Islands Biosphere Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

NORTHWEST PACIFIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Nalychevo Nature Park and Marine Nature Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Far Eastern Marine Nature Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Dzhugdzhurskiy Nature Reserve (Zapovednik)	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Koryakskiy Nature Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Kronotskiy Biosphere Reserve (and Zapovednik)	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
South Kamchatka Sanctuary	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Kurilskiy Nature Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Maliy Kurils Wildlife Refuge	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Lazovskiy Nature Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Sikhote-Alinskiy Biosphere Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

NORTHWEST PACIFIC

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Magadanskiy Nature Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Poronayskiy Nature Reserve	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Vostok Bay National Comprehensive Marine Sanctuary	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Piltun and Chayvo Offshore Feeding Grounds	Northwest Pacific	Russia	Y	Western Pacific gray whale	N	N	Y	Y	N	N	Eligible	Eligible	Eligible	Whale Refuge	None
Shantar Archipelago National Park	Northwest Pacific	Russia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

SOUTHEAST PACIFIC

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Eastern Tropical Pacific Seascape	Southeast Pacific	International	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Francisco Coloane National Marine Park	Southeast Pacific	Chile	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Caldera MPA	Southeast Pacific	Chile	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Bahía Mansa MPA	Southeast Pacific	Chile	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Humboldt Penguin National Reserve	Southeast Pacific	Chile	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Chiloe National Park	Southeast Pacific	Chile	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Isla Gorgona National Natural Park	Southeast Pacific	Columbia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Ensenada de Utría National Natural Park	Southeast Pacific	Columbia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Malaga Bay MPA	Southeast Pacific	Columbia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

SOUTHEAST PACIFIC

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Cocos Island Marine and Terrestrial Conservation Area	Southeast Pacific	Costa Rica	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Ballena Marine National Park	Southeast Pacific	Costa Rica	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Costa Rica Dome	Southeast Pacific	Costa Rica	Y	Blue whale humpback whale	N	N	Y	Y	N	N	Eligible	Eligible	Eligible		
Galápagos Marine Resources Reserve*	Southeast Pacific	Ecuador	N	Blue whale sperm whale Galapagos sea lion (endemic) Galapagos fur seal (endemic)	N	N	Y	Y	N	N	Not Eligible	Eligible	Not Eligible	Whale Refuge	None
Manglares-Churute Ecological Reserve	Southeast Pacific	Ecuador	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Cuyabeno Faunistic Reserve	Southeast Pacific	Ecuador	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Machalilla National Park	Southeast Pacific	Ecuador	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Cerro Hoya National Park	Southeast Pacific	Panama	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Coiba National Park	Southeast Pacific	Panama	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

SOUTHEAST PACIFIC

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Coiba National ParkSpecial Marine Protection Zone	Southeast Pacific	Panama	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Special Marine Protection Zone	II
Golfo de Chiriquí National Marine Park	Southeast Pacific	Panama	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
El Golfo de Montijo Wetland	Southeast Pacific	Panama	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Paracas National Reserve	Southeast Pacific	Peru	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Pacaya-Samiria National Reserve	Southeast Pacific	Peru	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Peninsula Bayovar MPA	Southeast Pacific	Peru	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

AUSTRALIA—NEW ZEALAND

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Australian Whale Sanctuary (Coast to EEZ limit)	Australia - New Zealand	Australia	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Whale Sanctuary	None
Great Barrier Reef Marine Park Between 16°E and 21°S	Australia - New Zealand	Australia	Y	Humpback whale dwarf minke whale	N	Y	N	N	N	N	Eligible	Eligible	Eligible	Marine Park	Ia, II, IV, VI
Solitary Islands Marine Reserve and Marine Park	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Coringa-Herald and Lihou Reef National Nature Reserve	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Mermaid Reef Marine National Nature Reserve	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Lord Howe Island Marine Park and World Heritage Area	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Elizabeth and Middleton Reefs Marine Nature Reserve	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

AUSTRALIA—NEW ZEALAND

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Tasmanian Seamounts Marine Reserve	Australia - New Zealand	Australia	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Marine Reserve	Ia, VI
Macquarie Island Marine Park and World Heritage Area	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible	Marine Park	Ia, IV
Ningaloo Marine Park	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Bonney Upwelling Blue Whale Feeding critical habitat MPA	Australia - New Zealand	Australia	Y	Blue whale pygmy blue whale New Zealand fur seal southern right whale Australian sea lion	N	N	Y	N	N	N	Eligible	Eligible	Eligible		
Moreton Bay Marine Park	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Hervey Bay Marine Park	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

AUSTRALIA—NEW ZEALAND

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Queensland MPAs: Cairns Marine Park, Trinity Inlet-Marlin Coast Marine Park, Mackay Capricorn Marine Park, Woongarra Marine Park, Townsville Whitsunday Marine Park, Gumoo Woojabuddee Marine Park, Gulf of Carpentaria Marine Park, Torres Strait Indigenous Protected Area	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
New South Wales MPAs: Cape Byron Marine Park, Jervis Bay Marine Park, Port Stephens Marine Park	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

AUSTRALIA—NEW ZEALAND

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Victoria MPAs: Bunurong Marine National Park, Wilsons Promontory Marine National Park, Cape Howe Marine National Park, Churchill Marine National Park, Discovery Bay Marine National Park, Ninety Mile Beach Marine National Park, Point Addis Marine National Park, Point Hicks Marine National Park, Port Phillip Heads Marine National Park, The Twelve Apostles Marine National Park, Yaringa Marine National Park, Merri Marine Sanctuary	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

AUSTRALIA—NEW ZEALAND

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Great Australian Bight Marine National Park	Australia - New Zealand	Australia	Y		N	N	N	N	N	N	Eligible	Not Eligible	Not Eligible	Marine National Park	VI
Head of Bight: Great Australian Bight Marine National Park	Australia - New Zealand	Australia	Y	Southern right whale Australian sea lion	N	Y	N	N	N	N	Eligible	Eligible	Eligible		
Encounter Bay MPA	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Adelaide Dolphin Sanctuary	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

AUSTRALIA—NEW ZEALAND

	Geography			Biology							Criteria		Preliminary Result	Additional Information	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Western Australia MPAs: Shoalwater Islands Marine Park, Marmion Marine Park, Jurien Bay Marine Park, Shark Bay Marine Park and World Heritage Area, Rowley Shoals Marine Park, The Capes Marine Park, Monte Bellos/Barrow Island Marine Reserve, Garig Gunak Barlu National Park	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Tasmania MPAs: Governor Island Marine Reserve	Australia - New Zealand	Australia	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
New Zealand Marine Mammal Sanctuary	Australia - New Zealand	New Zealand	N		N	N	N	N	N	N	Not Eligible	Not Eligible	Not Eligible		

AUSTRALIA—NEW ZEALAND

	GEOGRAPHY			BIOLOGY							CRITERIA		PRELIMINARY RESULT	ADDITIONAL INFORMATION	
Area	Marine Region[1]	Country	Outside the Coastal Standoff Distance or Non-OpArea (1)	Species[2]	High Density (2a)	Breeding Calving (2b)	Foraging Grounds (2b)	Migration Route (2b)	Critical Habitat (2b)	Small, Distinct Population (2c)	Criterion 1: Coastal Standoff Distance	Criterion 2: Concentration Area 2a, 2b, or 2c	Nomination Status	Designation	IUCN Category
Auckland Islands Marine Mammal Sanctuary and Marine Reserve	Australia - New Zealand	New Zealand	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Banks Peninsula Marine Mammal Sanctuary	Australia - New Zealand	New Zealand	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Akaroa Harbour Marine Reserve (Part of Banks Peninsula Reserve)	Australia - New Zealand	New Zealand	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
Doubtful Sound Marine Sanctuary	Australia - New Zealand	New Zealand	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		
West Coast Marine Park	Australia - New Zealand	New Zealand	N		U	U	U	U	U	U	Not Eligible	Unknown	Not Eligible		

APPENDIX D-4: SURTASS LFA MARINE MAMMAL OBIA REVIEWERS (SUBJECT MATTER EXPERTS [SMES]), 2 AUGUST 2010

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Australia

No volunteers

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APPENDIX D-5: NMFS' LETTER TO NAVY RE: MARINE MAMMAL OFFSHORE BIOLOGICALLY IMPORTANT AREAS (OBIAS) FOR SURVEILLANCE TOWED ARRAY SENSOR SYSTEM LOW FREQUENCY ACTIVE (SURTASS LFA) SONAR, 16 JUNE 2010

Date: June 16, 2010

To: Branch Head, Undersea Surveillance (N2/N6F21)
Department of the Navy,
Office of the Chief of Naval Operations
2000 Navy Pentagon
Washington, DC 20350

Re: Marine Mammal Offshore Biologically Important Areas (OBIAs) for Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) Sonar.

Thank you for the opportunity to participate as a cooperating agency in the preparation of the Navy's second Draft Supplemental Environmental Impact Statement (DSEIS2) for SURTASS LFA sonar, including the identification of OBIAs for the conservation of marine mammals. The enclosed document titled "*Recommendations for Marine Mammal Offshore Biologically Important Areas (OBIAs) for the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar"* presents 45 suggestions for OBIAs in the Atlantic, Indian and Pacific Oceans and Mediterranean and Caribbean Seas, which NMFS recommends you consider in the development of your alternatives for the DSEIS2.

As you are aware, NMFS and, separately, a panel of Subject Matter Experts (SMEs) compiled information to identify and support the recommended designation of OBIAs based on specific criteria that NMFS laid out in advance. Subsequently, NMFS reviewed each recommendation (i.e., NMFS' own initial recommendations and the SME's contributions) and ranked it based upon the quality of the data to support the designation of the given area based on each of the two criteria.

To ensure that the nominated areas were ranked consistently, NMFS assigned a rank of zero to four (i.e., 0 = lowest, 4 = highest) to qualify the robustness of the supporting documentation for each criteria that the area was nominated. These ranking categories are as follows:

– Rank 0: Not Eligible, not applicable
– Rank 1: Not Eligible, insufficient data
– Rank 2: Eligible for consideration, requires more data
– Rank 3: Eligible for consideration, adequate justification
– Rank 4: Eligible for consideration, strong justification

Of the initial 77 recommendations, 45 received a ranking of 2, 3, or 4 for at least one criterion.

Separate from the ranking of the data that support a criterion, NMFS also assigned a rank for the robustness of the supporting documentation for each proposed boundary. These ranking categories are as follows:

– Rank 0: SME did not provide boundary information.

– Rank 1: Clear justification (qualitative or quantitative) for boundary consideration is not available.

– Rank 2: Proposed boundary inferred from analyses conducted for purposes other than quantifying the boundary.

– Rank 3: Proposed boundary inferred from peer-reviewed analyses.

– Rank 4: Proposed boundary is well documented and/or codified by national law or regulation.

Table 1 (attached) provides an example as to how NMFS defined and described the ranking criteria for evaluating NMFS' and the SME's recommendations.

Several of the SMEs submitted boundaries that appear to include a buffer zone around the identified area of biological importance. Within the time allotted for this process, in some cases, NMFS was unable to amend the size of the boundaries to remove the buffers so that the size of the suggested OBIA comports with the data provided. Where applicable, NMFS has identified these areas with an asterisk and the following statement: "*NMFS: The proposed boundary appears to have a buffer zone that extends beyond the identified area of biological importance.*"

We understand that the Navy will consider many factors in the development of their alternatives and the decisions regarding whether to include each of these suggested areas as proposed OBIAs in their DSEIS2; however, we ask that the Navy include all of the information that NMFS has compiled in the Appendices of the DSEIS2 so that the public has the most complete set of information to comment on and potentially augment.

As we have previously discussed, NMFS plans to solicit additional input from the SMEs regarding habitat ranking for the OBIA recommendations (based on biological importance, not strength of supporting information). Additionally, we anticipate that the public, as well as the SMEs, may bring additional pertinent information to bear during the DSEIS2 public comment period. Last, the Navy has biological expertise as well, and we expect that the information used to support the inclusion/non-inclusion of certain suggested areas as proposed OBIAs in the DSEIS2 will further inform this process. Once the Navy has submitted an MMPA application under section 101(a)(5) of the Marine Mammal Protection Act (MMPA), all of this additional information will be considered in NMFS' decisions regarding what OBIAs to propose pursuant to the MMPA authorization process.

We look forward to our next meeting with the Navy on the identification of OBIAs.

Thank you.

APPENDIX D-6: RECOMMENDATIONS FOR MARINE MAMMAL OFFSHORE BIOLOGICALLY IMPORTANT AREAS (OBIAS) FOR THE SURVEILLANCE TOWED ARRAY SENSOR SYSTEM LOW FREQUENCY ACTIVE (SURTASS LFA) SONAR, 16 JUNE 2010

Recommendations for Marine Mammal Offshore Biologically Important Areas (OBIAs) for the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar

National Marine Fisheries Service
Office of Protected Resources
August 10, 2011

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Table 1 – NMFS' Classification Methodology for OBIA Recommendations

Level	Level Description for High Density, Foraging, Breeding/Calving, Migration, or Small Distinct Populations	Level Description Boundary Consideration
0	Information not provided or information presented does not meet NMFS' definition of the corresponding OBIA criteria or the OBIA criteria are not applicable.	SME did not provide boundary information.
1	Clear justification (qualitative or quantitative) for corresponding OBIA criteria is not available; or the SME did not provide sufficient detail to NMFS for criteria evaluation; or for high density specifically, the SME provided strong abundance/presence information, but without the comparative information that supports *high* density.	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.
2	Designation inferred from analyses conducted for purposes other than quantifying the corresponding OBIA criteria. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.	Proposed boundary inferred from analyses conducted for purposes other than quantifying the boundary. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.
3	Designation inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at investigating and supporting the corresponding OBIA criteria. Information presented from a single source or is generally imprecise (e.g., CV => 30%).	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at investigating and supporting the proposed boundary.
4	Designation inferred from peer-reviewed analyses or surveys specifically aimed at investigating and supporting the corresponding OBIA criteria. Information presented is from multiple sources or is generally precise (e.g., CV < 30%).	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973).

Table 2 - List of Recommendations and NMFS' Classification of Supporting Data

Name	High Density	Foraging	Breeding Calving	Migration	Critical Habitat	Small Distinct	Highest Score
Georges Bank	3	4	0	4	0	0	4
Roseway Basin Right Whale Conservation Area	0	4	0	0	0	0	4
Great South Channel	0	3	0	0	4	0	4
The Gully Marine Protected Area	4	3	0	0	0	0	4
Southeastern U.S. Right Whale Seasonal Habitat	0	0	4	0	4	0	4
Silver Bank and Navidad Bank	0	0	4	0	0	0	4
Coastal Waters of Gabon, Congo and Equatorial Guinea	1	1	4	4	0	2	4
Patagonian Shelf Break	0	4	0	0	0	0	4
Southern Right Whale Seasonal Habitat	0	0	4	0	0	0	4
Northern Bay of Bengal and Swatch-of-No-Ground	1	2	2	0	0	4	4
Coastal Waters off Madagascar	1	1	4	1	0	0	4
Madagascar Plateau, Madagascar Ridge, Walters Shoal	1	3	4	3	0	2	4
Central California National Marine Sanctuaries	4	4	0	4	0	0	4
Vaquita Habitat in the Northern Gulf of California	0	0	0	0	0	4	4
Southern California Bight	0	4	0	4	0	0	4
Gulf of Alaska Steller Sea Lion Critical Habitat	0	0	0	0	4	0	4
Okhotsk Sea	0	4	0	2	0	0	4
Area around Ischia Island and Regno di Nettuno Marine Protected Area	1	1	3	0	0	0	3
Area in the Northern Adriatic Sea	1	2	3	0	0	0	3

Table 2 - List of Recommendations and NMFS' Classification of Supporting Data

Name	High Density	Foraging	Breeding Calving	Migration	Critical Habitat	Small Distinct	Highest Score
Northeast Slope in the Ligurian-Corsican-Provençal Basin	0	3	0	0	0	0	3
Harbor Porpoise Take Reduction Management Areas	3	3	0	3	0	0	3
Cape Hatteras Special Research Area	3	3	0	0	0	0	3
Shortland Canyon and Haldimand Canyon	3	3	0	0	0	0	3
Gulf of Thailand	1	0	1	0	0	3	3
Penguin Bank	3	0	3	0	0	0	3
Costa Rica Dome	0	3	0	0	0	0	3
Cross Seamount	0	3	0	0	0	0	3
Great Barrier Reef Between 16°E and 21°S	0	0	3	0	0	0	3
Bonney Upwelling	0	3	0	0	0	0	3
Southwest Mediterranean	1	2	2	0	0	0	2
North Alboran Sea, Gulf of Vera, Southern Almeria	1	2	2	0	0	0	2
Avenzar Bank, Câbliers Bank, and El Mansour Seamount	1	2	2	0	0	0	2
Djibouti Bank, Ville de Djibouti Bank, and Alborán Channel	1	2	2	0	0	0	2
Barcelona Canyon, Tarragona Canyon, Mallorca Chanel, Pituisas Canyon	1	2	2	0	0	0	2
Southern Almería, Seco de los Olivos Seamount, Alborán Island, Águilas Seamount	1	2	2	0	0	0	2
Felibres Hills, Calypso Hills, Spinola Spur, and Montpelier Canyon	1	2	2	0	0	0	2

Table 2 - List of Recommendations and NMFS' Classification of Supporting Data

Name	High Density	Foraging	Breeding Calving	Migration	Critical Habitat	Small Distinct	Highest Score
Marseille Canyon, Cassis Canyon, Felibres Hill, Alabe Hill, Barcelona Canyon	1	2	0	0	0	0	2
Area off of Southwest Greece and Crete, Ptolemy Mountains, Cretan-Rhodes Ridge	1	2	2	0	0	0	2
Northwest of Challenger Bank	0	2	0	1	0	0	2
Sylt Outer Reef	1	0	2	0	0	0	2
Pommeranian Bay, Adler Ground, and Western Ronne Bank	0	0	2	0	0	0	2
Buenos Aires Province Coastal Area	1	2	2	0	0	2	2
Area in the Ombai Strait in the Savu Sea Marine Protected Area	0	2	0	2	0	0	2
Fairweather Grounds, Southeast Alaska	0	2	0	0	0	0	2
Olympic Coast: The Prairie, Barkley Canyon, and Nitnat Canyon	0	2	0	0	0	0	2
Sardinian Seamount, Comino Trough, Sardinia, Corsica Trough	1	0	0	0	0	0	1
Peñiscola Canyon, Valencia Basin, Benidorm Canyon, Alicante Canyon, Águilas Seamount	1	0	0	0	0	0	1
Mediterranean Sea West of 10° E Ligurian Sea to Gibralter Strait	1	0	0	0	0	0	1
Pelagos Cetacean Sanctuary	1	0	0	0	0	0	1

Table 2 - List of Recommendations and NMFS' Classification of Supporting Data

Name	High Density	Foraging	Breeding Calving	Migration	Critical Habitat	Small Distinct	Highest Score
Caprera Canyon, Giglio Ridge, Oblia Terrace – Southeast of Pelagos Sanctuary	1	0	0	0	0	0	1
Area off Eastern Sicily, East of Messina Canyon	1	0	0	0	0	0	1
Area off the Gaza Strip and the Western Coast of Israel	1	0	0	0	0	0	1
Song of the Whale Surveys - Eastern Mediterranean	1	0	0	0	0	0	1
Dogger Bank	1	0	0	0	0	0	1
Continental Slope of the Northern Gulf of Mexico	1	1	0	0	0	0	1
Canary Islands Cetacean Marine Sanctuary	1	0	0	0	0	0	1
Tristan da Cunha Cetacean Sanctuary	1	0	0	0	0	0	1
Komodo National Park, Biosphere Reserve	1	0	0	0	0	0	1
Beaked Whale Habitat in the Coastal Waters off California, Washington, and Oregon	1	0	0	0	0	0	1
Southern Gulf of California	1	0	0	0	0	0	1
Exclusion around Japan and the Ryukyu Islands	1	0	0	0	0	0	1
The Sea of Japan	1	0	0	0	0	0	1
Exclusion in the South China Sea	1	0	0	0	0	0	1
Exclusion for the West Philippine Sea	1	0	0	0	0	0	1
Area around Quarqannah Island	0	0	0	0	0	0	0
Area Malta Island and Malta Plateau	0	0	0	0	0	0	0

Table 2 - List of Recommendations and NMFS' Classification of Supporting Data

Name	High Density	Foraging	Breeding Calving	Migration	Critical Habitat	Small Distinct	Highest Score
Total Exclusion within the Yellow Sea / East China Sea	0	0	0	0	0	0	0
Exclusion around Taiwan	0	0	0	0	0	0	0
Total Exclusion in the Gulf of Tonkin	0	0	0	0	0	0	0
Exclusion around Wake Island	0	0	0	0	0	0	0
Exclusion for the North Philippine Sea	0	0	0	0	0	0	0
Exclusion for the East China Sea	0	0	0	0	0	0	0

IUCN Marine Region 3: Mediterranean Sea

Southwest Mediterranean Sea (South of Sardinia to Alborán Sea - IFAW Survey)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Sperm whale (*Physeter macrocephalus*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 1*	SME provided a KMZ file. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- One of the areas with highest sperm whale densities in the Mediterranean. Whales feed and breed here. Considering that there is some genetic exchange between Mediterranean and Atlantic sperm whales, the Alborán Sea can be considered a migration corridor between the two regions (Lewis, 2010).
- On the assumption that g(0)=1, standard DISTANCE analysis gives an abundance estimate for the survey block of 561 animals (Lewis, 2010).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	0
Status	Not Eligible	Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	Requires more Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

North Alborán Sea, Gulf of Vera, Southern Almeria (Spain)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Short-Beaked Common Dolphin (*Delphinus delphis)* Striped dolphins (*Stenella coeruleoalba*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 2*	SME provided a KMZ file. Area proposed covers coast to 30 nm seaward of the Andalusian Coast. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	Year-round.

Background Provided by SME

- Paper describes mostly short-beaked common dolphins; however this and other studies clearly emphasize importance of area for: a) high densities of a number of odontocete species, which feed and breed there year-round (Cañadas & Hammond, 2008).
- Area covered in map is only the one which was surveyed: critical habitat of described species certain to extend much further to the south, possibly all the way to the Moroccan and Algerian coasts.
- Ana Cañadas and colleagues have published during the past decade or so a large number of papers detailing the importance of the N. Alboran Sea for a number of odontocete species. These include long-finned pilot whales (*Globicephala melas*), Risso's dolphins (*Grampus griseus*), Cuvier's beaked whales (*Ziphius cavirostris*), common bottlenose dolphins (*Tursiops truncates*). (Notarbartolo di Sciara, 2010).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	0
Status	Not Eligible	Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	Requires more Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Avenzar Bank, Câbliers Bank, and El Mansour Seamount—MED 09 Surveys (Spain)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Cuvier's beaked whale (*Ziphius cavirostris*) Long-finned pilot whale (*Globicephala melas*) Risso's dolphin (*Grampus griseus*) Common dolphin (*Delphinus delphis*) Striped dolphin (*Stenella coeruleoalba*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 3*	SME provided a KMZ file. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density area for species mentioned.
- Breeding and feeding known to occur in the area for all of them.
- Alborán East: area covered by [Med-09] cruise, where a very large number of sightings were made (in 45 hours of effort: 67 Cuvier's beaked whales, 168 long-finned pilot whales, 89 Risso's dolphins, 304 short-beaked common dolphins, 870 striped dolphins, plus a number of mixed-species groups and unidentified cetaceans) is certainly much smaller than the area actually used by the concerned populations (Anon., 2010).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	0
Status	Not Eligible	Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	Requires more Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Djibouti Bank, Ville de Djibouti Bank, and Alborán Channel—MED 09 Surveys (Spain)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Cuvier's beaked whale (*Ziphius cavirostris*) Long-finned pilot whale (*Globicephala melas*) Risso's dolphin (*Grampus griseus*) Common dolphin (*Delphinus delphis*) Striped dolphin (*Stenella coeruleoalba*) Bottlenose dolphin (*Tursiops truncatus*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 4*	SME provided a KMZ file.* ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density area for species mentioned.
- Breeding and feeding known to occur in the area for all of them.
- Alborán West: area covered by cruise, where a very large number of sightings were made (in 60 hours of effort: 56 Cuvier's beaked whales, 71 long-finned pilot whales, 38 Risso's dolphins, 222 short-beaked common dolphins, 550 striped dolphins, plus a number of mixed-species groups and unidentified cetaceans) is certainly much smaller than the area actually used by the concerned populations (Anon., 2010; Notarbartolo di Sciara, 2010).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	0
Status	Not Eligible	Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	Requires more Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Sardinian Seamount, Comino Trough, Sardinia/Corsica Trough—MED 09 Surveys (Sardinia/Italy)

Potential Criteria:	2A: High Density
Species of Concern:	Fin whale (*Balaenoptera physalus*) Sperm whale (*Physeter macrocephalus*) Cuvier's beaked whale (*Ziphius cavirostris*) Bottlenose dolphin (*Tursiops truncatus*) Common dolphin (*Delphinus delphis*) Striped dolphin (*Stenella coeruleoalba*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 5*	SME provided a KMZ file.* ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Tyrrhenian Sea: area covered by cruise, where a very large number of sightings were made (in 53 hours of effort: 27 fin whales, 24 sperm whales, 12 Cuvier's beaked whales, 4 bottlenose dolphins, 45 short-beaked common dolphins, 366 striped dolphins, plus a number of mixed-species groups and unidentified cetaceans) is certainly much smaller than the area used by the concerned populations (Anon., 2010).
- Breeding and feeding known to occur in the area for all of them.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Barcelona Canyon, Tarragona Canyon, Mallorca Chanel, Pituisas Canyon (Spain and France)

Potential Criteria:	2A: High Density 2B: Critical Habitat 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Bottlenose dolphin (*Tursiops truncatus*) Sperm whale (*Physeter macrocephalus*) Striped dolphin (*Stenella coeruleoalba*) Fin whale (*Balaenoptera physalus*) Risso's dolphin (*Grampus griseusz*) Long-finned pilot whale (*Globicephala melas*) Common dolphin (*Delphinus delphis*) Unidentified beaked whale
Proposed Boundary Consideration: *Basis: Notobartolo di SciaraNumbers 6 and 7*	SME provided a KMZ file*. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Area contains critical habitat of the species (i.e., *Tursiops*) which feeds and breeds there (Forcada, Gazo, Aguilar, Gonzalvo, & Fernández-Contreras, 2004; Notarbartolo di Sciara, 2010).
- Breeding and feeding known to occur in the area for at least all odontocetes.
- Large number of sightings of different species made during two summer cruises in 2003 and 2004 testify importance of Balearic waters for cetacean ecology and biodiversity (Notarbartolo di Sciara, 2010; Rendell, Cañadas, & Mundy, 2005).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	1	0

NMFS’ Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	0
Status	Not Eligible	Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	Requires more Justification	N/A	N/A	N/A

NMFS’ Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance. .

Peñiscola Canyon, Valencia Basin, Benidorm Canyon, Alicante Canyon, Águilas Seamount (Spain)

Potential Criteria:	2A: High Density
Species of Concern:	Fin whale (*Balaenoptera physalus*) Sperm whale (*Physeter macrocephalus*) Cuvier's beaked whale (*Ziphius cavirostris*) Bottlenose dolphin (*Tursiops truncatus*) Common dolphin (*Delphinus delphis*) Striped dolphin (*Stenella coeruleoalba*) Risso's dolphin (*Grampus griseus*) Long-finned pilot whale (*Globicephala melas*) Unidentified beaked whale
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 8*	SME provided a KMZ file*. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density area for species mentioned.
- Population estimates performed with aerial and vessel surveys demonstrated the high values of the study area for striped dolphins (mean abundance 15,778), bottlenose dolphins (1,333) and Risso's dolphins (493). (Gómez de Segura, Crespo, Pedraza, Hammond, & Raga, 2006; Notarbartolo di Sciara, 2010).

Number of Supporting Documents

Peer-Reviewed Article(s)	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Southern Almería, Seco de los Olivos Seamount, Alborán Island, Águilas Seamount (Spain)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Sperm whale (*Physeter macrocephalus*) Cuvier's beaked whale (*Ziphius cavirostris*) Bottlenose dolphin (*Tursiops truncatus*) Common dolphin (*Delphinus delphis*) Striped dolphin (*Stenella coeruleoalba*) Risso's dolphin (*Grampus griseus*) Long-finned pilot whale (*Globicephala melas*) Unidentified beaked whale
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 9*	SME provided a KMZ file*. * *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density area for species mentioned.
- Breeding and feeding known to occur in the area for all of them.
- "The results identified areas that are important for a number of cetacean species, thus illustrating the potential for MPAs to improve cetacean conservation generally in the Alborán Sea, a region of great importance for supporting biodiversity and ecological processes in the wider Mediterranean Sea (Cañadas, Sagarminaga, De Stephanis, Urquiola, & Hammond, 2005)."

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	0
Status	Not Eligible	Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	Requires more Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Felibres Hills, Calypso Hills, Spinola Spur, and Montpelier Canyon (France, Italy, Monaco)

Potential Criteria:	2B: Critical Habitat 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Striped dolphin (*Stenella coeruleoalba*) Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Numbers 10 and 12*	SME provided a KMZ file*. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Area (established as a cetacean sanctuary (i.e., Pelagos) contains critical habitat for a number of cetacean species, in particular the two listed here (striped dolphin and fin whale), which are known to feed and breed in the area .
- In a recent aerial survey, unpublished at present, fin whale numbers seen in 2009 are smaller than in previous years, but still substantive. Whales likely to have moved wider and ranging beyond Sanctuary waters.
- High density, feeding and breeding area.
- This area coincides with distribution detected during 1992 survey, described in Forcada J., Notarbartolo di Sciara G., Fabbri F. 1995. Abundance of fin whales and striped dolphins summering in the Corso-Ligurian Basin. (Forcada, Notarbartolo di Sciara, & Fabbri, 1995).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

1.1

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	0
Status	Not Eligible	Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	Requires more Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Mediterranean Sea West of 10° E – Ligurian Sea to Gibralter Strait (France, Italy, Monaco)

Potential Criteria:	2A: High Density
Species of Concern:	Striped dolphin (*Stenella coeruleoalba*) Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 11*	SME provided a KMZ file*. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Study indicates locations of distributional "hot spots" for both species in a large portion of the west Mediterranean.
- See also: Forcada J., Aguilar A., Hammond P.S., Pastor X., Aguilar R. 1994. Distribution and numbers of striped dolphins in the western Mediterranean Sea after the 1990 epizootic outbreak. Marine Mammal Science 10(2):137-150 (Forcada, Aguilar, Hammond, Pastor, & Aguilar, 2006).
- This area coincides with distribution detected during 1992 survey, described in Forcada J., Notarbartolo di Sciara G., Fabbri F. 1995. Abundance of fin whales and striped dolphins summering in the Corso-Ligurian Basin. Mammalia 59(1):127-140.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Marseille Canyon, Cassis Canyon, Felibres Hill, Alabe Hill, Barcelona Canyon (France, Italy)

Potential Criteria:	2A: High Density 2B: Foraging Area
Species of Concern:	Sperm whale (*Physeter macrocephalus*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 13*	SME provided a KMZ file*. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density, feeding area.
- Area stops at Lat 39° 35′ however there is just a small distance to cover to merge into area No. 1 (i.e., the Southwest Mediterranean - South of Sardinia to Alboran Sea - IFAW Survey recommendation (Anon., 2010)) so we should presume the two are contiguous .

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	0	0	0	0
Status	Not Eligible	Eligible	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Pelagos Cetacean Sanctuary (France, Italy, Monaco)

Potential Criteria:	2A: High Density
Species of Concern:	Striped dolphin (*Stenella coeruleoalba*) Sperm whale (*Physeter macrocephalus*) Fin whale (*Balaenoptera physalus*) Long-finned pilot whale (*Globicephala melas*) Risso's Dolphin (*Grampus griseus*) Cuvier's beaked whale (*Ziphius cavirostris*) Bottlenose dolphin (*Tursiops truncatus*) Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Numbers 14 and 15*	SME provided a KMZ file.
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High densities. High density confirmed also during winter.
- A total of 131 cetacean sightings of were made: striped dolphins (n=114), common bottlenose dolphins (7), fin whales (1), sperm whales (1), Cuvier's beaked whales (1) and unidentified small dolphins (7). Uncorrected striped dolphin population size was estimated to be 19,578 (% CV=19.2; 95% C.I.=12,318 – 27,039), with a density of 0.2218 individuals km-1 (%CV=19.23; 95% C.I.=0.1395-0.3063) (S. Panigada, Burt, Lauriano, Pierantonio, & Donovan, 2009).
- Panigada and Azzelino's (2009) report to the Italian Ministry of the environment, in Italian contains a summary of almost two decades of data, with spatial modeling to describe habitat for several species.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973).

Caprera Canyon, Giglio Ridge, Oblia Terrace – Southeast of Pelagos Sanctuary (Italy)

Potential Criteria:	2A: High Density
Species of Concern:	Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 16*	SME provided a KMZ file.
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High densities.
- Detected hitherto unsuspected high densities of fin whales (but also striped dolphin and common dolphin) outside of boundaries of Pelagos Sanctuary, to the southeast (Arcangeli et al., 2009).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	0	1

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Area around Ischia Island and Regno di Nettuno Marine Protected Area (Italy)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 17*	SME provided a KMZ file. *Note that many areas (Napoli Canyon, Ponza-Salerno Terrace) are within 12 nm of island coastlines.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- One of the few remaining strongholds for the species in the Mediterranean, outside of the Alborán Sea.
- An MPA (i.e., Ischia – Regno di Nettuno MPA) was established by the Italian Government in large part to protect cetaceans (these also include sperm whales, frequenting the Cuma Canyon north of the island of Ischia).
- 46 Recognizable individuals have been catalogued, 19 of these re-sighted in different years, suggesting significant levels of site fidelity. Breeding activities are often observed, and calves are always present in one or more of the group sub-units. Sighted groups are relatively large (mean=65.5, SD=23.94, n=41, range 35–100 individuals) and often observed in association with striped dolphins (*Stenella coeruleoalba*), particularly during surface feeding targeting shoaling prey (Mussi, Miragliuolo, & Bearzi, 2002).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	1	3	0	0	0
Status	Not Eligible	Not Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Insufficient Detail	Adequate Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973).

Area off Eastern Sicily, East of Messina Canyon (Sicily, Italy)

Potential Criteria:	2A: High Density
Species of Concern:	Sperm whale (*Physeter macrocephalus*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 20*	SME provided a KMZ file. *Note that many areas are within 12 nm of island coastlines except for a small portion.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High densities.
- "...marine biologists from the University of Pavia piggy-backed a sea mammal–monitoring experiment on [an] array [of four sensors off Sicily to see whether background noise is low enough to allow for acoustic detection of neutrinos]. The ensuing log, which is still being analyzed by both biologists and physicists, indicates hundreds of sperm-whale transits per year over an area of about 1,000 square kilometers" (Holden, 2007).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	0	1

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Area around Quarqannah Island (Tunisia)

Potential Criteria:	2B: Critical habitat
Species of Concern:	Bottlenose dolphin (*Tursiops truncatus*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 21*	SME provided a KMZ file. *Note that many areas are within 12 nm of coastline.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Presence of critical habitat.
- "La densité du Grand dauphin a été estimée à 0,19 animaux/km², avec un coefficient de variation de 33%. L'effectif estimé pour l'ensemble de la zone étudiée est de 3977 dauphins, avec un intervalle de confiance relativement large, de 1982 à 7584 animals."
- **Translation from Abstract:** This campaign, ASPIS 2003, concerned the zone of the 15 MN of Kélibia to Zarzis, in the east and the south of the country. The density of the common bottlenose dolphin was 0.19 per km^2 with a CV of 33%. The valued strength for the whole of the studied zone is 3,977 dolphins, with a relatively large confidence interval, of 1,982 to 7,584 animals. The relative abundance of the bottlenose dolphin was 0.1383 individuals per km^2. The species was however abundant in the Monastirs-Chebba and the Gabes Gulf zones. In the zone of the Cap Bon, the relative abundance was relatively weak compared to the other zones (Ben Naceur et al., 2004).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	0	0	0	0
Status	N/A	N/A	N/A	N/A	N/A	N/A
Assessment	N/A	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Area Malta Island and Malta Plateau (Malta)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding/Calving Area
Species of Concern:	Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 23*	SME provided a KMZ file. *Note that many areas are within 12 nm of coastline.* ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Vella's (2005) preliminary study, detected important presence of species and recommends further research/conservation effort.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	0	1

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	0	0	0	0
Status	Not Eligible	Not Eligible	Not Eligible	N/A	N/A	N/A
Assessment	Information not provided.	Information not provided.	Information not provided.	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Area in the Northern Adriatic Sea (Italy, Greece, Slovenia)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding/Calving Area
Species of Concern:	Bottlenose dolphin (*Tursiops truncatus*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Numbers 24 and 25*	SME provided a KMZ file*. *Note that many areas are within 12 nm of coastline.* ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Moderate density area; *Tursiops* is the only cetacean sighted.
- "…a total of 156 sightings between 1988 and 2007. Encounter rates ranged between 0.42 and 1.67 groups/100 km of effort (Bearzi et al., 2009).
- High density, breeding/calving area, foraging grounds (i.e., off the Slovenian coast).
- "…A total of 120 sightings ...101 dolphins identified" between 2002 and 2008. High rate of site fidelity. Offspring present in 53.3% of groups. Annual mark-recapture estimate 0.069 dolphins/km^2 (Genov, Kotnjek, Lesjak, Hace, & Fortuna, 2008).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	3	0	0	0
Status	Not Eligible	Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	Adequate Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Area off of Southwest Greece and Crete (Ptolemy Mountains, Cretan-Rhodes Ridge) (Greece)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding/Calving Area
Species of Concern:	Sperm whale (*Physeter macrocephalus*) Cuvier's beaked whale (*Ziphius cavirostris*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 30*	SME provided a KMZ file*. *Note that some areas are within 12 nm of coastline.* * *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density, breeding/calving area, foraging grounds.
- Frantzis and colleagues have collected vast amounts of additional data during yearly cruises, which however remain unpublished. Data include information on another deep-diving species *Ziphius cavirostris*, which also apparently has important habitat in the area (Frantzis et al., 1999).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	1	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migratio n Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	0
Status	Not Eligible	Eligible	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	Requires more Justification	Requires more Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Area off the Gaza Strip and the Western Coast of Israel (Palestine, Israel)

Potential Criteria:	2A: High Density
Species of Concern:	Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis: Notobartolo di Sciara Number 35*	SME provided a KMZ file. *Note that some areas are within 12 nm of coastline.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Hitherto unsuspected presence in large groups.
- Several sightings of large groups in recent years, contrasting with previous absence of the species from the area in the authors' collective experience (Scheninin, Kerem, & Goffman, 2010).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	1	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Northeast Slope in the Ligurian-Corsican-Provençal Basin

Potential Criterion:	2B: Foraging Area
Species of Concern:	Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: Location inferred from Azzellino et al. (2008).	8°35'23.085"E, 43°57'14.637"N 9°6'36.592"E, 43°56'30.726"N 9°6'21.955"E, 43°26'45.04"N 8°35'37.721"E, 43°26'59.677"N *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	July through August

Background

- The total size of the fin whale population in the Mediterranean is unknown. However, one study estimates that approximately 3500 individuals range in a portion of the western basin. High whale densities, comparable to those found in rich oceanic habitats, were found in well-defined areas of high productivity. Most whales concentrate in the Ligurian-Corsican-Provençal Basin; however, neither their movement patterns throughout the region nor their seasonal cycle are clear (Notarbartolo-Di-Sciara, Zanardelli, Jahoda, Panigada, & Airoldi, 2003).
- During the summer months, the species is known to concentrate in high numbers in the Corso-Ligurian Basin, described as one of the principal feeding grounds for fin whales in the Mediterranean Sea (Notarbartolo-Di-Sciara, et al., 2003)
- One nine-year study surveyed a total of 73,046 km and reported 540 sightings of fin whales in the Ligurian Sea. Water depth was the most significant variable in describing fin whale distribution, with more than 90% of sightings occurring in waters deeper than 2,000m (S Panigada et al., 2005).
- One study sought to correlate marine mammal presence in the Ligurian Sea with physical and biological parameters collected during NATO's SACLANT Undersea Research Centre's sea trials, called Sirena. The data suggested that large (sperm and fin) whales were predominately found in the deeper portion of the basin (D' Amico et al., 2003).
- In the western Ligurian Sea, many submarine canyons at the boundary between neritic and oceanic domains create the conditions for the accumulation of migratory micronektonic species in the continental slope waters. One study suggests that the periodic pattern of concentration of pelagic zooplankton near the bottom above the slope may provide an abundant food source for organisms living in the slope area, and it could also be the reason for the occasional presence of fin whales over the upper slope (Azzellino, Gaspari, Airoldi, & Nani, 2008)
- Most of the fin whale sightings occurred along the 2000-m depth contour. Also, Fin whales showed also a periodic east-to west pattern in their movements during the July–August period. Such a pattern suggests once more a relationship with the counter-clockwise circulation of the Liguro-Provenc- al-Catalan Current (Azzellino, et al., 2008).
- Azzellino et al. (2008) noted that bottlenose dolphin, Risso's dolphin, sperm whale and Cuvier's beaked whale were all found associated with well-defined depth and slope gradients showing very clear preferences for specific physical habitats, respectively, the shelf-edge, the upper slope and the lower slope.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	3	0	0	0	0
Status	N/A	Eligible	N/A	N/A	N/A	N/A
Assessment	N/A	Adequate Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

IUCN Marine Region 4: Northwest Atlantic Ocean

Harbor Porpoise Take Reduction Management Areas (United States)

<table>
<tr><td>Potential Criteria:</td><td>2A: High Density
2B: Migration Route
2B: Foraging Area</td></tr>
<tr><td>Species of Concern:</td><td>Harbor porpoise (Phocoena phocoena)</td></tr>
<tr><td>Proposed Boundary Consideration:

Basis: U.S. Government These areas are designated in the Harbor porpoise take reduction plan (75 FR 7402; 19 February 2010).</td><td>
MID-COAST MANAGEMENT AREA
<table>
<tr><th>Point</th><th>N. lat.</th><th>W. long.</th></tr>
<tr><td>MC1</td><td>42°30.0′</td><td>70°50.1′ (MA shoreline).</td></tr>
<tr><td>MC2</td><td>42°30.0′</td><td>70°15.0′</td></tr>
<tr><td>MC3</td><td>42°40.0′</td><td>70°15.0′</td></tr>
<tr><td>MC4</td><td>42°40.0′</td><td>70°00.0′</td></tr>
<tr><td>MC5</td><td>43°00.0′</td><td>70°00.0′</td></tr>
<tr><td>MC6</td><td>43°00.0′</td><td>69°30.0′</td></tr>
<tr><td>MC7</td><td>43°30.0′</td><td>69°30.0′</td></tr>
<tr><td>MC8</td><td>43°30.0′</td><td>69°00.0′</td></tr>
<tr><td>MC9</td><td>44°17.8′</td><td>69°00.0′ (ME shoreline).</td></tr>
</table>
STELLWAGEN BANK MANAGEMENT AREA
<table>
<tr><th>Point</th><th>N. lat.</th><th>W. long.</th></tr>
<tr><td>SB1</td><td>42°30.0′</td><td>70°30.0′</td></tr>
<tr><td>SB2</td><td>42°30.0′</td><td>70°15.0′</td></tr>
<tr><td>SB3</td><td>42°15.0′</td><td>70°15.0′</td></tr>
<tr><td>SB4</td><td>42°15.0′</td><td>70°30.0′</td></tr>
<tr><td>SB1</td><td>42°30.0′</td><td>70°30.0′</td></tr>
</table>
OFFSHORE MANAGEMENT AREA
<table>
<tr><th>Point</th><th>N. lat.</th><th>W. long.</th></tr>
<tr><td>OFS1</td><td>42°50.0′</td><td>69°30.0′</td></tr>
</table>
SOUTHERN NEW ENGLAND MANAGEMENT AREA
<table>
<tr><th>Point</th><th>N. lat.</th><th>W. long.</th></tr>
<tr><td>SNE1</td><td>Western boundary as specified[1]</td><td></td></tr>
<tr><td>SNE2</td><td>40°00.0′</td><td>72°30.0′</td></tr>
<tr><td>SNE3</td><td>40°00.0′</td><td>69°30.0′</td></tr>
<tr><td>SNE4</td><td>42°15.0′</td><td>69°30.0′</td></tr>
<tr><td>SNE5</td><td>42°15.0′</td><td>70°00.0′</td></tr>
<tr><td>SNE6</td><td>41°58.3′</td><td>70°00.0′ (MA shoreline).</td></tr>
</table>
[1] Bounded on the west by a line running from the Rhode Island shoreline at 41°18.2′ N. lat. and 71°51.5′ W. long. (Watch Hill, RI), southwesterly through Fishers Island, NY, to Race Point, Fishers Island, NY; and from Race Point, Fishers Island, NY; southeasterly to the intersection of the 3-nautical mile line east of Montauk Point; southwesterly along the 3-nautical mile line to the intersection of

OFFSHORE MANAGEMENT AREA—Continued
<table>
<tr><th>Point</th><th>N. lat.</th><th>W. long.</th></tr>
<tr><td>OFS2</td><td>43°10.0′</td><td>69°10.0′</td></tr>
<tr><td>OFS3</td><td>43°10.0′</td><td>67°40.0′</td></tr>
<tr><td>OFS4</td><td>43°05.8′</td><td>67°40.0′ (EEZ boundary).</td></tr>
<tr><td>OFS5</td><td>42°53.1′</td><td>67°44.5′ (EEZ boundary).</td></tr>
<tr><td>OFS6</td><td>42°47.3′</td><td>67°40.0′ (EEZ boundary).</td></tr>
<tr><td>OFS7</td><td>42°10.0′</td><td>67°40.0′</td></tr>
<tr><td>OFS8</td><td>42°10.0′</td><td>69°30.0′</td></tr>
<tr><td>OFS1</td><td>42°50.0′</td><td>69°30.0′</td></tr>
</table>
MUDHOLE NORTH MANAGEMENT AREA
<table>
<tr><th>Point</th><th>N. lat.</th><th>W. long.</th></tr>
<tr><td>MN1</td><td>40°28.1′</td><td>74°00.0′ (NJ shoreline).</td></tr>
<tr><td>MN2</td><td>40°30.0′</td><td>74°00.0′</td></tr>
<tr><td>MN3</td><td>40°30.0′</td><td>73°20.0′</td></tr>
<tr><td>MN4</td><td>40°05.0′</td><td>73°20.0′</td></tr>
<tr><td>MN5</td><td>40°05.0′</td><td>74°02.0′ (NJ shoreline).</td></tr>
</table>
MUDHOLE SOUTH MANAGEMENT AREA
<table>
<tr><th>Point</th><th>N. lat.</th><th>W. long.</th></tr>
<tr><td>MS1</td><td>40°05.0′</td><td>73°31.0′</td></tr>
<tr><td>MS2</td><td>40°05.0′</td><td>73°00.0′</td></tr>
</table>
MUDHOLE SOUTH MANAGEMENT AREA—Continued
<table>
<tr><th>Point</th><th>N. lat.</th><th>W. long.</th></tr>
<tr><td>MS3</td><td>39°51.0′</td><td>73°00.0′</td></tr>
<tr><td>MS4</td><td>39°51.0′</td><td>73°31.0′</td></tr>
<tr><td>MS1</td><td>40°05.0′</td><td>73°31.0′</td></tr>
</table>
</td></tr>
<tr><td>Proposed Temporal Consideration:</td><td>Regions outside of 12-nmi from the coast within the following areas:
Mid-Coast Management Area: September 15 through May 31
Stellwagen Bank Management Area: November 1 through May 31
Southern New England Management Area: December 1 through May 31
Offshore Management Area: November 1 through May 31
Mudhole North: January 1 through April 30
Mudhole South: January 1 through April 30</td></tr>
</table>

Background Provided by SME

- The Gulf of Maine/Bay of Fundy harbor porpoise (*Phocoena phocoena*) stock annually migrate through U.S. Atlantic waters from North Carolina in the winter to the Gulf of Maine and Bay of Fundy in the summer (Palka, Read, Westgate, & Johnston, 1996). They are in the northern Gulf of Maine and lower Bay of Fundy, Canada region during July and begin to migrate out during September. During September to December and April to June, they are seen in the lower Gulf of Maine and off the Atlantic coast of Nova Scotia near Halifax, although not in the numbers observed in the Bay of Fundy. During December to March, some of the population is presumed to be offshore of the US mid-Atlantic, from North Carolina to Massachusetts, as indicated by beach strandings (Haley & Read, 1993) and several sighting surveys (Northridge, 1996; Palka, 1995; Read, 1999; Winn, 1982). Although a few strandings have been found in Florida, the typical southerly boundary is Cape Hatteras, North Carolina (Palka, et al., 1996).
- The Gulf of Maine/Bay of Fundy harbor porpoise stock is considered a strategic stock because human-related mortalities exceed the potential biological removal (PBR) level (Waring, Josephson, Fairfield-Walsh, & Maze-Foley, 2009).
- Harbor porpoises are small sized, so they are unable to carry large energy stores (Koopman, 1998). Thus, their patterns of movement are likely to be strongly related to the distribution of their prey (Johnston, Westgate, & Read, 2005). Their primary prey are juvenile Atlantic herring *Clupea harengus harengus* though they also feed on silver hake *Merluccius bilinearis*, hake *Urophycis* spp. and pearlsides *Maurolicus weitzmani* (Gannon, Craddock, & Read, 1998).
- Because during the harbor porpoise's annual migrations they have consistently been found to inhabit certain regions in high to intermediate density levels where their prey are commonly found and where gillnet fishing commonly occurs, management actions have been developed to reduce the bycatch of harbor porpoises during specific times in specific management areas (75 FR 7383-7402; 19 February 2010). These times and areas (detailed above in the Proposed Temporal Consideration section) are clearly important habitat for this species and should receive appropriate protection. Management actions include restricting gillnet fishing or require gillnets to use pingers.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	3	1	0	0	4	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	3	3	0	3	0	0
Status	Eligible	Eligible	N/A	Eligible	N/A	N/A
Assessment	Adequate Justification	Adequate Justification	N/A	Adequate Justification	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed .

Cape Hatteras Special Research Area (United States)

Potential Criterion:	2A: High Density 2B: Foraging Area
Species of Concern:	Pilot whale spp. (*Globicephala* spp.)
Proposed Boundary Consideration:	An area bounded by the following coordinates: 75 º W, 36º 25'N 74 º W, 36º 25'N 74 º W, 35 º N 75 º W, 35 º N
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- Mixing of shelf, slope and Gulf Stream water over the continental shelf edge of the Middle Atlantic Bight near Cape Hatteras, North Carolina results in upwelling and Gulf Stream meanders (Churchill, Levine, Connors, & Cornillon, 1993)
- (Böhm, Hopkins, Pietrafesa, & Churchill, 2006; Churchill, et al., 1993). This creates a highly productive region which allows temperate and tropical marine species to flourish; species ranging from larval fish (Hare et al., 2002) to cetaceans (DON, 2007b; Garrison et al., 2003; Waring, et al., 2009).
- The Cape Hatteras Special Research Area, an area off Cape Hatteras within the above productive region, has a high density of pilot whales and high bycatch rates of pilot whales in the pelagic long line fishery (74 FR 23349-23358; May 19, 2009).
- Inside this Research Area, pelagic long line fishers are required to carry an observer on board, if requested, and to participate in focused research on pilot whale interactions with the pelagic longline fishery.
- Sightings of pilot whales (*Globicephala sp*.) in the western North Atlantic occur primarily near the continental shelf break ranging from Florida to the Nova Scotian Shelf (Mullin & Fulling, 2003). The long-finned pilot whale (*Globicephala melaena*) is distributed from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea (Abend, 1993; Abend & Smith, 1999; Buckland, Anderson, Burnham, & Laake, 1993; Leatherwood, Caldwell, Winn, Schevill, & Caldwell, 1976; Sergeant, 1962). Long-finned pilot whales and short-finned pilot whales (*Globicephala macrorhynchus*) overlap spatially along the mid-Atlantic shelf break between Cape Hatteras, North Carolina and New Jersey (Garrison, Martinez, & Maze-Foley, (in review); Payne & Heinemann, 1993). In addition, short-finned pilot whales are documented along the continental shelf and continental slope in the northern Gulf of Mexico (Hansen, Mullin, Jefferson, & Scott, 1996; Mullin & Fulling, 2003; Mullin & Hoggard, 2000), and they have also been seen in the wider Caribbean.
- Pilot whales are bycaught in the U.S. Atlantic pelagic longline, mid-Atlantic midwater trawl and the mid-Atlantic bottom trawl fisheries (Waring, et al., 2009).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
6	1	0	0	1	6	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	3	3	0	0	0	0
Status	Eligible	Eligible	N/A	N/A	N/A	N/A
Assessment	Adequate Justification	Adequate Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

Georges Bank (United States)

Potential Criterion:	2A: High Density 2B: Foraging Area 2B: Migration Route
Species of Concern:	North Atlantic Right whale (*Eubalaena glacialis*) Beaked whales (*Mesoplodon* spp. and *Ziphius* spp.)
Proposed Boundary Consideration:	An area bounded by the following coordinates: 40º 00' N, 72º 30' W 39º 20' N, 71º 54' W 39º 30' N, 71º 25' W 39º 45' N, 69º 00' W 40º 26' N, 66º 43' W 41º 45' N, 65º 26' W 42º 20' N, 66º 06' W 42º 18' N, 67º 23' W ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically designated area of biological importance.*
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- Georges Bank is a region very rich with marine life, ranging from plankton to marine mammals (Link et al., 2008; Steele et al., 2007) and is among the most diverse, productive, and trophically complex marine temperate areas in the world (Link, et al., 2008; Overholtz & Link, 2007).
- The northern edge of Georges Bank is a relative shallow, cool region where the Georges Bank anti-cyclonic frontal circulation system deposits abundant amounts of copepods, such as *Calanus* (Durbin et al., 2003). As a result of this abundant food, the northern edge of Georges Bank is a foraging area for many cetaceans including endangered whales, such as right whales (*Eubalaena glacialis*), humpback whales (*Megaptera novaeangliae*), sei whales (*Balaenoptera borealis*), and fin whales (*Balaenoptera physalus*), and a variety of small cetaceans, such as pilot whales (*Globicephala spp.*), white-sided dolphins (*Lagenorhynchus acutus*), common dolphins (*Delphinus delphis*), and Risso's dolphins (*Grampus griseus*) (DON, 2007a; Pace & Merrick, 2008; Palka, 2006; Rossman, 2009; Selzer & Payne, 1988; Vigness-Raposa, Kenney, Gonzalez, & August, 2009; Waring, et al., 2009; Winn, 1982)
- The southern edge of Georges Bank is a different habitat with its warmer shelf-slope front, many deep canyons (e.g. Hydrographer and Oceanographer canyons), warm intrusions of the Gulf Stream, and steep shelf edge (Mooers et al. 1979). This habitat also has high densities of cetaceans, though some of the species are different from the northern edge of Georges Bank. Species commonly found foraging on the southern edge of Georges Bank include beaked whales (Mesoplodon spp. and Ziphius spp.), fin whales, sperm whales (*Physeter macrocephalus*), pilot whales, spotted dolphins (*Stenella attenuata*), striped dolphins (*Stenella coeruleoalba*), offshore bottlenose dolphins (*Tursiops truncatus*), Risso's dolphins, and common dolphins (DON, 2007a, 2007b; Hamazaki, 2002; Palka, 2006; Selzer & Payne, 1988; Waring, et al., 2009).
- In addition, the cetacean density is even larger because some species migrate through Georges Bank and do not reside for long time periods on George Bank. Examples of these species are harbor porpoises (*Phocoena phocoena*), minke whales (*Balaenoptera acutorostrata*), and killer whales (*Orcinus orca*) (Hamazaki, 2002; Palka, Orphanides, & Warden, 2009).

- The species composition in the northern and southern edges of Georges Bank differs from season to season; however, in total there are high densities of foraging cetaceans during all parts of the year, where the winter has the lowest densities (DON, 2007a; Winn, 1982).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	0	0	0	0	8	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	3	4	0	4	0	0
Status	Eligible	Eligible	N/A	Eligible	N/A	N/A
Assessment	Adequate Justification	Strong Justification	N/A	Strong Justification	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Northwest of Challenger Bank (Bermuda)

Potential Criteria:	2B: Migration Route 2B: Foraging Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration: Location inferred from Stone et al. (1987)	The area around 65°19'11.214"W, 32°12'16.23"N *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	March and April

Background

- Historical accounts show that humpback whales have frequented Bermuda waters, which are located half-way between wintering and summering grounds in the western North Atlantic, since the early 17th century (Stone, Katona, & Tucker, 1987). Stone et al. (1987) suggested that humpback whales from the North Atlantic feed briefly and opportunistically at Bermuda (32°20'N) while migrating (Danilewicz, Tavares, Moreno, Ott, & Trigo, 2009).
- Humpback whales were common in Bermudian coastal waters during the late winter and spring (March-May); sperm whales, in offshore waters probably throughout much of the year (Reeves, Mckenzie, & Smith, 2006)
- Humpbacks utilize Bermuda as a mid-ocean habitat through which all members of the western North Atlantic population migrate during spring (Stone, et al., 1987).
- Humpbacks returning to their northern feeding grounds may take more westerly routes that in many cases pass close to Bermuda where as suggested by Stone et al. (1987), they may linger and feed (Clapham & Mattila, 1990).
- Stone et al. (1987) suggest that the presence of humpbacks at Bermuda, a way-point during the springtime northward migration, may be attributed to increased food availability, providing the first opportunity to feed after the wintering ground fast (Baraff, Clapham, Mattila, & Bowman, 1991).
- There is also evidence suggesting that humpback whales feed at Bermuda on deep water scattering layers during their stop-over (Stone, et al., 1987).
- It seems likely that humpbacks returning to their northern feeding grounds may take more westerly routes that in many cases pass close to Bermuda where, as suggested by Stone et al. (1987), they may linger and feed (Clapham & Mattila, 1990).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
5	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	2	0	1	0	0
Status	N/A	Eligible	N/A	Not Eligible	N/A	N/A
Assessment	N/A	Requires More Data	N/A	Insufficient Detail	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

Roseway Basin Right Whale Conservation Area (Canada)

Potential Criterion:	2B: Foraging Grounds
Species of Concern:	North Atlantic right whale (*Eubalena glacialis*)
Proposed Boundary Consideration: Basis: Canadian Government.	An area bounded by the following coordinates: NW 43° 05'N, 65° 40'W NE 43° 05'N, 65° 03'W SW 42° 45'N, 65° 40'W SE 42° 45'N, 65° 03'W
Proposed Seasonal Consideration:	*Canadian Restriction is June through December.*

Background

- In 2008, Transport Canada implemented the Roseway Basin Area to be Avoided (ATBA) following its adoption by the International Maritime Organization (IMO). The measure is seasonal and recommended for all vessels ≥ 300 gross tonnage from June through December. The aim of this ATBA is to protect the endangered North Atlantic right whale from ship strikes and to enhance maritime safety (IMO, 2007).
- From 1999 to 2001, Baumgartner et al. (2003) conducted surveys in Roseway Basin to investigate the physical and biological oceanographic factors associated with North Atlantic right whale occurrence. They noted that right whales in these regions fed on *Calanus finmarchicus*.
- Spatial variability in right whale occurrence was associated with water depth and the depth of the bottom mixed layer. *C. finmarchicus* CS aggregated over the deepest water depths in both regions, and within these areas, right whales occurred where the bottom mixed layer forced discrete layers of *C. finmarchicus* to occur shallower in the water column (allowing more efficient foraging) (Baumgartner, et al., 2003).
- Baumgartner et al. (2003) concluded that annual increases in right whale occurrence appeared to be associated with decreases in sea surface temperature (SST) in both regions; however, they any further observation merits based on the short duration of the three-year study.
- Baumgartner et al. (2003) concluded that spatial variability in right whale occurrence was associated with water depth and the depth of the bottom mixed layer, within the Bay of Fundy and Roseway Basins. Copepods (*Calanus finmarchicus*) aggregated over the deepest water depths in these areas. Within these areas, right whales occurred where the bottom mixed layer forced discrete layers of *C. finmarchicus* to occur shallower in the water column, which allows more efficient foraging.
- The spatial and interannual variability in occurrences observed for right whales might be associated with the SST gradient, a proxy for ocean fronts (Baumgartner, et al., 2003).
- The summer feeding areas are in waters near Nova Scotia and the principal spring feeding ground (April-June) is in the GSC (Kenney & Wishner, 1995).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	4	0	0	0	0
Status	N/A	Eligible	N/A	N/A	N/A	N/A
Assessment	N/A	Strong Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

Great South Channel (United States)

Potential Criteria:	2B: Critical Habitat 2B: Foraging Area
Species of Concern:	North Atlantic right whale (*Eubalena glacialis*)
Proposed Boundary Consideration: Basis: U.S. Government.	It is bounded by the following coordinates: 42°30′00.0″ N, 069°45′00.0″ W 41°40′00.0″ N, 069°45′00.0″ W 41°00′00.0″ N, 069°05′00.0″ W 42°09′00.0″ N, 067°08′24.0″ W 42°30′00.0″ N, 067°27′00.0″ W 42°30′00.0″ N, 069°45′00.0″ W *This area is within designated critical habitat.*
Proposed Seasonal Consideration:	*Ship Strike Rule is April 1 to July 31.*

Background

- The Great South Channel (GSC) area lies east of Cape Cod, Massachusetts, U.S.A. between Nantucket Shoals on the west and Georges Bank on the east. Right whales are the world's most endangered large whale species, and the GSC is the principal feeding ground of the western North Atlantic population (Kenney & Wishner, 1995).
- The South Channel Ocean Productivity Experiment (SCOPEX), a multidisciplinary study of a whale-zooplankton predator-prey system in the southwestern Gulf of Maine, confirmed the co-occurrence of right whales with high density *Calanus finmarchicus* patches. Also, the whales fed on patches with higher proportions of larger lifestages of *C. finmarchius* (Kenney & Wishner, 1995).
- The summer feeding areas are in waters near Nova Scotia and the principal spring feeding ground (April-June) is in the GSC (Kenney & Wishner, 1995).
- Right whales were only rarely observed in the GSC during the fall and winter seasons. Most sightings occurred in April, May, and June, with a large peak in sighting frequency in May (Kenney, Winn, & Macaulay, 1995).
- In the Great South Channel Seasonal Management Area, NOAA has proposed an April through July requirement that all vessels over 300 gross tons travel no faster than 10 knots. To physically separate whales and vessels, NOAA has also considered designating the Great South Channel critical habitat area as an International Maritime Organization-approved Area To Be Avoided (ATBA). NMFS proposed seasonal restriction of the April through July based on the number of greatest sighting densities found in the southwest corner of the GSC Critical Habitat (Merrick & Cole, 2007).
- NMFS designated this area as critical habitat and an important feeding area for the North Atlantic right whale in 1994 (NMFS, 1994).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migratio n Route	Critical Habitat	Small Distinct Population
Rank	0	3	0	0	4	0
Status	N/A	Eligible	N/A	N/A	Eligible	N/A
Assessment	N/A	Adequate Justification	N/A	N/A	Strong Justification	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

The Gully Marine Protected Area (Canada)

Potential Criteria:	2A: High Density 2B: Foraging Grounds
Species of Concern:	Northern bottlenose whales (*Hyperoodon ampullatus*)
Proposed Boundary Consideration: Basis: Canadian Government	An area bounded by the following coordinates: 44°13′ N, 59°06′ W to 43°47′ N, 58°35′W; 43°35′ N, 58°35′ W to 43°35′ N, 59°08′ W to 44°06′ N, 59°20′ W
Proposed Seasonal Consideration:	Year Round

Background

- The Gully, a submarine canyon off eastern Canada, was nominated as a pilot Marine Protected Area (MPA) in 1998, largely to safeguard the vulnerable population of northern bottlenose whales (Hooker, Whitehead, & Gowans, 2002).
- Northern bottlenose whales are consistently found through the year in the Gully (Whitehead, Gowans, Faucher, & McCarrey, 1997).
- A small, apparently isolated, and endangered population of approximately 130 northern bottlenose whales is found on the Scotian Slope south of Nova Scotia, Canada (Wimmer & Whitehead, 2004).
- A ship survey along the 1,000 m depth contour in 2001 showed northern bottlenose whales only in the Gully, Shortland Canyon, and Haldimand Canyon. Studies in 2002 reconfirmed the presence of the whales in the other canyons, although densities were about 50% lower than in the Gully (Wimmer & Whitehead, 2004)
- Hooker et al. (2002) estimated the energy consumption of bottlenose whales in The Gully and suggested that there must be a substantial spatial subsidy in the underlying food web of the submarine canyon to support the bottlenose whales using the Gully. Studies of this species' diet elsewhere in the North Atlantic Ocean have suggested specialization on the deep-sea squid, Gonatus fabricii (Hooker, Iverson, Ostrom, & Smith, 2001).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	4	3	0	0	0	0
Status	Eligible	Eligible	N/A	N/A	N/A	N/A
Assessment	Strong Justification	Adequate Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

Shortland Canyon and Haldimand Canyon (Canada)

Potential Criteria:	2A: High Density 2B: Foraging Grounds
Species of Concern:	Northern bottlenose whales (*Hyperoodon ampullatus*)
Proposed Boundary Consideration: Location inferred from Wimmer and Whitehead (2004)	An area bounded by the following coordinates: 58°38'16.385"W, 44°11'56.984"N 57°54'5.541"W, 44°31'42.32"N 57°42'35.89"W, 44°8'43.019"N 58°29'39.147"W, 43°50'23.889"N
Proposed Seasonal Consideration:	Year Round

Background

- On the Scotian Shelf, northern bottlenose whales have been sighted most often in the deep waters of three underwater canyons (the Gully, Shortland Canyon, and Haldimand Canyon) along the shelf edge. They are thought to be year-round residents but winter distribution is not understood (DFO, 2007)
- The carrying capacity (the maximum number of individuals that a given environment can support) of northern bottlenose whales on the Scotian Shelf is unknown. The density of whales is higher in the Gully than in the other two canyons. This could indicate that there is room for population expansion in Shortland and Haldimand canyons. However a large canyon such as the Gully can have proportionately higher productivity due to its oceanographic and bathymetric (ocean depths) characteristics suggesting that it would be able to support higher densities of whales than smaller canyons (DFO, 2007).
- Haldimand and Shortland canyons are clearly important habitat for this species, and should receive appropriate protection. Research in 2002 confirmed that northern bottlenose whales regularly use Shortland and Haldimand canyons (Wimmer & Whitehead, 2004).
- Northern bottlenose whales were encountered in Shortland and Haldimand canyons at a rate about half that in The Gully, which suggests about half the density. Also, the whales seem to prefer waters between about 800 and 1500 m deep within all three canyons (Wimmer & Whitehead, 2004).
- Although there have been several sightings of northern bottlenose whales in other areas on and surrounding the Scotian Slope, the only areas in which we know they can be reliably found are the Gully and Shortland and Haldimand canyons (Wimmer & Whitehead, 2004) .
- Northern bottlenose whales do move between the three canyons. The function of this movement can be considered from the perspective of optimal foraging on dispersed patches of prey. As the Gully (the richer patch) fills with more northern bottlenose whales, individuals would likely do better in terms of individual net gain to use other, albeit poorer, areas with fewer competitors (Haldimand and Shortland canyons and other areas (Wimmer & Whitehead, 2004).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	3	3	0	0	0	0
Status	Eligible	Eligible	N/A	N/A	N/A	N/A
Assessment	Adequate Justification	Adequate Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

IUCN Marine Region 5: Northeast Atlantic Ocean

Dogger Bank (OSPAR International)

Potential Criterion:	2A: High Density
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration:	None submitted.
Proposed Seasonal Consideration:	None submitted.

Background

- In 2002 and 2003, Germany's Federal Agency for Nature Conservation (BfN) conducted aerial surveys in the German EEZ and 12 nm zone to assess proposed Sites of Community Importance under the European Union (EU) Habitats Directive. The BfN found that the densities estimated for this site were fairly high, indicating an important area for porpoises. Also, Dogger Bank was the only area where sightings of other species could be observed (white-beaked dolphin and minke whale) (Gilles, Herr, Lehnert, Scheidat, & Siebert, 2008).
- Other studies (Siebert et al., 2006) have collected data on the occurrence of harbour porpoises in German waters from 1988 to 2002 from dedicated aerial surveys, incidental sightings and strandings. In the article, Siebert et al. notes that aerial surveys conducted in 1995 and 1996 revealed a mean abundance of 4288 (in 1995) and 7356 harbour porpoises (in 1996) in the German North Sea study area. Further, they describe reports of 791 incidental sightings of harbour porpoise pods in German and partly Danish coastal waters of the North and Baltic Seas from 1988 to 2002.
- Siebert et al. (2006) also found that 996 harbour porpoise strandings along the German North Sea coast in the period 1990 to 2001. Only 17 animals were identified as by-catch.
- Siebert et al. (2006) noted that their observational data demonstrated a strong seasonality of harbour porpoise occurrence off the German coast with highest numbers during the summer months.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Sylt Outer Reef (Germany)

Potential Criteria:	2A: High Density 2B: Calving Grounds
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration:	None submitted.
Proposed Seasonal Consideration:	None submitted.

Background

- In 2002 and 2003, Germany's Federal Agency for Nature Conservation (BfN) conducted aerial surveys in the German EEZ and 12 nm zone to assess proposed Sites of Community Importance under the European Union (EU) Habitats Directive. The BfN found that the densities estimated for this site were fairly high, indicating an important area for porpoises.
- Giles et al. (2008) noted that the highest density was estimated for Sylt Outer Reef (2002: 2.7 individuals/km^2; 2003: 3.7 individuals/km^2).
- Important habitats for harbour porpoises were detected west of the islands of Sylt and Amrum in the North Sea and around the Schlei estuary, in waters west of Fehmarn and the Fischland-Darss area in the Baltic Sea (Siebert, et al., 2006).
- In the BfN evaluation of sites in the North Sea, only the Sylt Outer Reef was delineated for porpoises using the criteria of Article 4.1 Habitats Directive. There, three selection criteria were positively validated: (1) continuous or regular presence, (2) good population density, and (3) a high ratio of mother-calf pairs (60%) (Gilles, et al., 2008).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	3	0	0	0
Status	Not Eligible	N/A	Eligible	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	Adequate Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

IUCN Marine Region 6: Baltic Sea

Pommeranian Bay, Adler Ground, and Western Ronne Bank (Germany)

Potential Criterion:	2B: Breeding Area
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration:	None submitted.
Proposed Seasonal Consideration:	Spring - Fall

Background

- The harbor porpoise is the only resident cetacean species in the German Baltic Sea (Scheidat, Gilles, Kock, & Siebert, 2008).
- One study (Verfuß et al., 2007) indicated regular presence of harbor porpoises within the Baltic Sea and noted that the porpoise usage patterns of the area indicated geographical and seasonal variation.
- The larger numbers of harbor porpoise detections in spring to autumn compared with winter suggests that the German Baltic Sea is an important breeding and mating area for these animals (Verfuß, et al., 2007).
- A recent Danish effort (http://www2.dmu.dk/Pub/FR657.pdf) to designate and identify areas of high harbor porpoise density has collected all relevant data on movements and density of the harbor porpoises in Danish and adjacent waters.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	2	0	0	0
Status	N/A	N/A	Eligible	N/A	N/A	N/A
Assessment	N/A	N/A	Requires More Data	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

IUCN Marine Region 7: Caribbean

Continental Slope of the Northern Gulf of Mexico (United States)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Critical Habitat
Species of Concern:	Sperm whale, several cetacean species
Proposed Boundary Consideration: *Basis: T. Jefferson*	Between 200 and 1,000 meter depth contours. **NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited (Sparks, 1997) and (O'Hern & Biggs, 2009) for support.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	1	0	0	0	0
Status	Not Eligible	Not Eligible	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	Insufficient Detail	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Southeastern U.S. Right Whale Seasonal Habitat (United States)

Potential Criteria:	2B: Calving Area 2B: Designated Critical Habitat
Species of Concern:	North Atlantic right whale (*Eubalena glacialis*)
Proposed Boundary Consideration: Basis: U.S. Government	The coastal waters between 31°15' N and 30°15' N from the coast out 15 nautical miles; and the coastal waters between 30°15' N and 28°00' N from the coast out 5 nautical miles. *This area is within designated critical habitat.*
Proposed Seasonal Consideration:	November through March

Background

- NMFS has designated critical habitat for the NARW in coastal waters of the southeastern United States (SEUS) (NMFS, 1994). This area is the only known calving ground for NARW off the SEUS in the winter (Kraus, Hamilton, Kenney, Knowlton, & Slay, 2001).
- The NARW calving season extends from late November through early March with an observed peak in January. The presence of females with calves was primarily limited to the coastal waters between 27°30'N and 32°00'N latitudes (NMFS, 1994).
- Based on the number of calves and females with calves in the SEUS since 1980, NMFS considers the SEUS as the primary calving area for the population (NMFS, 1994).
- Keller et al. (2006) found that SST likely plays an important role in the distribution of right whales in the southeastern, winter habitat. Warm Gulf Stream waters, generally found south and east of delineated critical habitat, represent a thermal limit for right whales and play an important role in their distribution within the calving grounds (Keller et al., 2006).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	4	0	4	0
Status	N/A	N/A	Eligible	N/A	Eligible	N/A
Assessment	N/A	N/A	Strong Justification	N/A	Strong Justification	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

Silver Bank and Navidad Bank (Dominican Republic)

Potential Criteria:	2B: Breeding Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration:	An area bounded by the following coordinates: 70°1'44.244"W, 20°54'55.121"N 69°39'45.454"W, 20°55'36.078"N 68°46'39.063"W, 20°17'6.149"N 68°31'13.453"W, 19°48'1.415"N 69°3'18.394"W, 19°55'40.124"N 70°2'8.817"W, 20°16'17.001"N *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	December through April

Background

- One survey conducted between 14 February and 19 March 1984 reported 317 whales were individually identified from photographs of ventral fluke patterns. Analysis of matches suggests that whales from the various high-latitude feeding stocks mix randomly on Silver Bank. Overall, the number of whales, calves, and surface-active groups observed during this study confirms the apparently singular importance of Silver Bank to the breeding ecology of western North Atlantic humpback whales (Mattila, Clapham, Katona, & Stone, 1989).
- Fast moving groups containing three or more adult humpback whales are found in the winter on Silver Bank in the West Indies. Many of these groups (Mattila, et al., 1989) have a definite structure: a central Nuclear Animal, with or without a calf, is surrounded by escorts who compete, sometimes violently, for proximity to the Nuclear Animal (Tyack & Whitehead, 1982).
- The humpback whales which winter in the West Indies are principally found over banks which are at latitudes between 10° and 22° N, have substantial areas of flat bottom between 15 and 60 m deep, and lie less than 30 km from the North Atlantic 2000-m contour. The surface sea temperatures in these areas are between 24 and 28° C (Whitehead & Moore, 1982).
- The major concentrations of the humpbacks, which feed little in winter, are on Silver and Navidad banks. On Silver Bank the humpback and humpback song densities peak in the centre of the Bank. Mothers with calves are generally found in areas of calm water, and singers are found over areas with a flat bottom, where they meander slowly (Whitehead & Moore, 1982).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	4	0	0	0
Status	N/A	N/A	Eligible	N/A	N/A	N/A
Assessment	N/A	N/A	Strong Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

IUCN Marine Region 8: West Africa

Canary Islands Cetacean Marine Sanctuary (Canary Islands)

Potential Criteria:	2A: High Density 2B: Critical Habitat
Species of Concern:	Short-finned Pilot Whale (*Globicephala macrorhynchus*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	*This area is a proposed nationally-designated marine mammal sanctuary.* The proposed boundary for the sanctuary could encompass: either all or portion of national waters to the limit of the EEZ of the Canary Islands, or possibly the waters between the islands, with or without the main whale watch areas off southwest Tenerife and La Gomera. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The Canary Islands represent a major area of concentration for the short-finned pilot whale (*Globicephala macrorhynchus*).
- This population is resident and is under significant stress from ship strikes and poorly-regulated whale-watching activities (Heimlich-Boran, 1993).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Tristan da Cunha Cetacean Sanctuary (British Overseas Territory)

Potential Criteria:	2A: High Density 2B: Critical Habitat
Species of Concern:	Tasman beaked whale (*Tasmacetus shepherdi*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	*This area is a nationally-designated marine mammal sanctuary.* SME did not submit a spatial file.
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- This subantarctic island has recently been found to contain a relatively high concentration of Shepherd's beaked whale (*Tasmactus shepherdi*), a beaked whale species that is considered rare and presumably highly-susceptible to impacts from naval sonar (Best, Glass, Ryan, & Dalebout, 2009).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
0	SME did not provide boundary information.

Coastal Waters of Gabon, Congo and Equatorial Guinea (West Africa)

Potential Criteria:	2A: High Density (*TJ, HR*) 2B: Breeding / Calving (*TJ, HR*) 2B: Foraging Grounds (*HR*) 2B: Migratory Route (*HR*) 2B: Critical Habitat (*TJ, HR*) 2C: Small, Distinct Population (*HR*)
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) (*TJ, HR*) Blue Whale (*Balaenoptera musculus*) (*HR*) Sperm Whale (*Physeter macrocephalus*) (*HR*) Beaked Whales (Ziphiidae) (*HR*) Bottlenose Dolphins (*Tursiops truncates*) (*HR*) Atlantic Humpback Dolphins (*Sousa teuszii*) (*HR*) Melon-headed Whales (*Peponocephala electra*) (*HR*)
Proposed Boundary Consideration: *Basis: T. Jefferson, H. Rosenbaum. Published literature, IWC reports and Wildlife Conservation Society unpublished data*	Territorial sea to 20 nm offshore. (*TJ*) Coasts of Gabon, Congo, and Equatorial Guinea to 40 nm. (*HR*) ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	Year-round (*HR*)

Background Provided by SME

- Well documented breeding habitat and migratory corridor for humpback whales, with particularly good documentation of dense aggregations in coastal waters of Gabon, particularly areas around Port Gentil, and the coastal shelf north and south to Luanda and northwards to Bioko (Findlay, 2001; Rosenbaum & Collins, 2006; Townsend, 1935; Walsh, Fay, Gulick, & Sounguet, 2000) and (Collins et al., 2008; Rosenbaum et al., 2009; Strindberg, Ersts, Collins, Sounguet, & Rosenbaum, In Press).
- Documented presence of the rare and likely endangered Atlantic Humpback dolphin in coastal waters of Gabon and Congo. The global population is small, and their range heavily fragmented. Gabon and Congo may host the healthiest habitat and populations remaining (low hundreds). (Collins, Ngouessono, & Rosenbaum, 2004; Van Waerebeek et al., 2004).
- Presence of sperm whales and beaked whales (Best, 2007; Townsend, 1935; Weir, 2006b, 2007).
- High biodiversity documented in the Port Gentil region due to the convergence of habitat suitable for both inshore, shallow water, and offshore, deep water species (Rosenbaum & Collins, 2006; Weir, 2006a) Findlay et al. 2006; Best 2007).
- Blue whales recorded on multiple occasions in the inshore waters of Northern Angola during dedicated study in 2008 (WCS unpublished data). Whaling catch record also suggests blue whales form a typical component of the cetacean species assemblage of the area (Best, 2007; Branch et al., 2007).
- Humpback whales (*Megaptera novaeangliae*) use the waters offshore of Gabon as a major breeding area in the Southern Hemisphere winter. There is concern about the impacts of extensive oil exploration and extraction has on the population, which has been studied in detail for several years (Rosenbaum & Collins, 2006).

- **[New Data - TJ]** Although their current status in waters of Congo and Equatorial Guinea are unknown, the coastal waters of Gabon are inhabited by an apparently small and localized population of Atlantic humpback dolphins (*Sousa teuszii*), which is listed by the IUCN as Vulnerable to extinction. Several sightings of these animals have been made there in recent years and preliminary evidence suggests that all populations of this species are small and fragmented (Collins, et al., 2004; Van Waerebeek, et al., 2004). In addition, these dolphins are highly vulnerable to impacts from oil exploration and extraction, which occurs along much of the West Africa coast.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
11	2	0	0	0	4	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	1	4	4	0	2
Status	Not Eligible	Not Eligible	Eligible	Eligible	Not Eligible	Eligible
Assessment	Insufficient Detail	Insufficient Detail	Strong Justification	Strong Justification	Does not qualify.	Requires More Data

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

IUCN Marine Region 9: South Atlantic Ocean

Buenos Aires Province Coastal Area (Argentina)

Potential Criterion:	2A: High Density 2B: Breeding / Calving 2B: Foraging Area 2C: Small, Distinct Population
Species of Concern:	Franciscana dolphin (*Pontoporia blainvillei*), Burmeister's Porpoise (*Phocoena spinipinnis*)
Proposed Boundary Consideration: *Location inferred from H. Rosenbaum*	The coastal waters of the Buenos Aires Province, from the coast out 10 nautical miles, between 35°00'S and 38°57'S. The coastal waters of the Buenos Aires Province, from the coast out 50 nautical miles, between 38°57'S and 40°37'S, to cover the island systems in the area. The coastal waters of the Buenos Aires Province, from the coast out 10 nautical miles, between 40°37'S and 42°00'S. *This area includes 12 nationally and/or internationally (UNESCO) designated marine protected areas* (*MPAs*)
Proposed Temporal Consideration:	Year-Round

Background Provided by SME

- The Franciscana dolphin is endemic to the Southwestern Atlantic Ocean, from Northern Brazil to Northern Argentina, and has been recognized as the most endangered cetacean in the region (Bordino et al., 2002; Secchi, Danilewicz, & Ott, 2003).
- This species is listed as Vulnerable by the IUCN and in Appendix II of CITES. The Burmeister's porpoise is endemic to the coasts of South America, from Southern Brazil to Northern Peru. This species is listed as conservation dependent-Data Deficient by the IUCN and in Appendix II of CITES. The coastal area of the Buenos Aires represents the southern limit of the Franciscana dolphin distribution range, and approaches the northern distribution range limit of Burmeister's porpoises.
- Density estimations for Franciscanas in the Buenos Aires area range between 0.37 and 0.48 ind/km^2 in the Buenos Aires area, which translates to an estimated abundance of approximately 30,000 individuals for this area (Bordino, Albareda, & Fidalgo, 2004; Crespo, Pedraza, Grandi, Dans, & Garaffo, 2004; Crespo, Pedraza, Grandi, Dans, & Garaffo, 2010) .
- Recent genetic data shows clear evidence of population structure of Franciscanas in Argentina, within the Buenos Aires Area (Lázaro, Lessa, & Hamilton, 2004; Mendez, Rosenbaum, & Bordino, 2008). Specifically, Mendez and colleagues provided evidence of at least three distinct populations in this area: one in northern Buenos Aires in the Samborombón area, at least one in eastern Buenos Aires between 36°30' deg. S and 38°00' deg. S., and at least another isolated population in southern Buenos Aires between 38°00' deg. S. and the species' distribution limit at 42°00' deg. S. (Mendez, et al., 2008; Mendez, Rosenbaum, Yackulic, Subramaniam, & Bordino, 2010). This genetic evidence is strongly supported by satellite tracking data for the species in northern and southern Buenos Aires (Bordino & Wells, 2005; Bordino, Wells, & Stamper, 2008).
- Based on environmental data and studies of fish community structure and abundance (Lasta, 1995; Lasta & Acha, 1996), coupled with the genetic evidence of *Franciscana* population structure in

Buenos Aires, Mendez et al. (2008) suggested that northern Buenos Aires could be a feeding area and calving ground for these dolphins.

- Genetic evidence suggests the existence of at least three isolated populations of Burmeister's porpoises along their distribution range: one population in coastal Peru, a second one in southern Chile, and a third one in Southern Argentina (Rosa et al., 2005). Because the Argentinean samples were collected in the Tierra del Fuego Province, over 2000 km of linear coastal distance from Buenos Aires, it is likely that future studies including specimens in this area uncover further population structure in Argentina.
- The Buenos Aires coastal area includes the following designated MPAs: Bahía de Samborombón (RAMSAR), Bahía San Blas-Isla Gama (National), Caleta de los Loros (National), Campos del Tuyú (National), Complejo Islote Lobos (National), Costero del Sur (National) ,Parque Costero del Sur (UNESCO), Dunas Atlántico Sur Mar Chiquita (National), Islas Embudo, Bermeja y Trinidad (National), Mar Chiquito (UNESCO), Punta Bermeja (National), and Rincon de Ajo (National).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	3	0	0	1	0	1

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	2
Status	Not Eligible	Eligible	Eligible	N/A	N/A	Eligible
Assessment	Insufficient Detail	Requires More Data	Requires More Data	N/A	N/A	Requires More Data

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance. .

Patagonian Shelf Break (Argentina)

Potential Criterion:	2B: Foraging Area
Species of Concern:	Southern elephant seal (*Mirounga leonina*)
Proposed Boundary Consideration: *Location inferred from Campagna et al. (1995, 1998, 1999, 2006) and Falabella et al. (2009). H. Rosenbaum*	Relevant areas are located between the isobaths of 200 and 2000 meters and the following latitudes: 1) 35°00'S and 39°00'S 2) 56°30'S and 58°30'S 3) 40°40'S and 42°30'S 2) 46°00'S and 48°50'S
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- The breeding aggregation of southern elephant seal at Peninsula Valdes is estimated to number some 50,000 individuals one year old or older. It is the only colony for the species that grew during about three decades and is today stable.
- Contrary to all other colonies of southern elephant seals, Peninsula Valdes is continental and is located in temperate waters rather than Antarctic of subantarctic waters (Campagna & Lewis, 1992).
- During foraging seasons (up to 7 month at sea), elephant seals combine exceptionally deep diving (up to 1500 m) with long-distance traveling, covering millions of square kilometers.
- The shelf break is an oceanic front exploited throughout the year by elephant seals. In summer (January – March) there is an intense use of the slope from the Rio de la Plata to the south of the San Jorge Gulf. In autumn, the main foraging areas are distributed to the south of the slope and around the Malvinas Islands (Falabella, Campagna, & Croxall, 2009).
- The shelf break front is a narrow transition region between subpolar and shelf waters that shows a moderate sea surface temperature front and chlorophyll-a maxima in summer resulting from upwelling created by the Malvinas Current interaction with the bottom topography (Romero, Piola, Charo, & Garcia, 2006; Saraceno, Provost, & Piola, 2005).
- During the foraging season, adults disperse widely, over millions of square kilometers. Females migrate longer distances than males, to the Argentine Basin. Males apparently prefer the edge of the continental shelf, which is much closer and more predictable in terms of productivity than the Basin. Juveniles behave as adults in terms of the extent of their migrations, although they show seasonal differences. While adults breed on land in the spring, juveniles are at sea, and while adult females are at sea after giving birth, juveniles molt on land see (Campagna, Fedak, & McConnell, 1999; Campagna, Le Boeuf, Blackwell, Crocker, & Quintana, 1995; Campagna et al., 2007; Campagna, Piola, Rosa Marin, Lewis, & Fernández, 2006; Campagna, Quintana, Le Boeuf, Blackwell, & Crocker, 1998; Campagna, Rivas, & Marin, 2000).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
9	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	4	0	0	0	0
Status	N/A	Eligible	N/A	N/A	N/A	N/A
Assessment	N/A	Strong Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed .

Southern Right Whale Seasonal Habitat (Argentina)

Potential Criteria:	2B: Calving Area 2B: Designated Critical Habitat
Species of Concern:	South Atlantic right whale (*Eubalena australis*)
Proposed Boundary Consideration: *Basis: H. Rosenbaum*	The coastal waters between 42°00'S and 43°00'S from the coast out 15 nautical miles including the enclosed bays of Golfo Nuevo, Golfo San Jose and San Matias *This area is contains designated calving habitat.*
Proposed Temporal Consideration:	May through December

Background Provided by SME

- The coastal waters surrounding Peninsula Valdes off the coast of Argentina contain one of the main calving areas for this species (Paine ref.).
- The southern right whale calving season extends from late May through late December with an observed peak in September. The presence of females with calves was primarily limited to the coastal waters between 42°00' S and 42°45'S latitudes (Paine et. Al, ref).
- Based on the number of females with calves in this area since 1970, this is considered one of the primary calving areas for the southern right whale population (Paine ref; Best ref).
- Although parts of Golfo Nuevo and all of Golfo San Jose have protected area status, southern right whales also range outside these bays throughout the season into Golfo San Matias and the Atlantic Ocean adjoining peninsula Valdes to 15nm from shore and further.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	4	0	0	0
Status	N/A	N/A	Eligible	N/A	N/A	N/A
Assessment	N/A	N/A	Strong Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance. .

IUCN Marine Region 10: Central Indian Ocean

Northern Bay of Bengal and Swatch-of-No-Ground (India)

Potential Criterion:	2A: High Density 2B: Breeding Calving 2B: Foraging Area 2C: Small, Distinct Population
Species of Concern:	Irrawaddy dolphin (*Orcaella brevirostris)* Finless porpoise (*Neophocaena phocaenoides)* Indo-Pacific humpback dolphin (*Sousa chinensis)* Indo-Pacific bottlenose dolphin (*Tursiops aduncus)* Bryde's whale (small form) (*Balaenoptera edeni)* Pantropical spotted dolphin (*Stenella attenuate)* Spinner dolphin (*S. longirostris)*
Proposed Boundary Consideration: Location inferred from Smith *et al*. (2008) and Mansur *et al.* (unpublished ms submitted to *Marine Mammal Science*) in Bangladesh waters and inferred from similar habitat in Indian waters.	Area is inclusive of the Swatch-of-No-Ground Submarine Canyon and adjacent coastal waters, Bangladesh and northeastern India. Polygon extending along the margins of the Sundarbans mangrove forest from a point in the east at 22º30'N, 91º40'E to a point in the west at 21º26'N, 87º41'E, following the Bangladesh coast south to 20º30'N, 92º30'E and to an offshore point at 20º30'N, 87º41'E, inclusive of the Swatch-of-No-Ground (SoNG) submarine canyon and St. Martin's Island. *This area lies adjacent to three UNESCO World Heritage sites in the Sundarbans and includes a proposed international Marine Protected Area for cetaceans in the SoNG (Bangladesh Cetacean Diversity Project, 2008)*
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- The coastal and deep-sea waters of Bangladesh have recently been identified as a global 'hotspot' of cetacean abundance and diversity (Smith, Ahmed, Mowgli, & Strindberg, 2008).
- Coastal waters are influenced by discharge from the third-largest river system in the world, the Ganges/Brahmaputra/Meghna (GBM), which supplies about 133 x 10^9mol yr^{-1} to the Bay of Bengal that is more than 1.5% of the total riverine input to the world's oceans (Sarin, Krishnaswami, Dilli, Somayajulu, & Moore, 1989) and a seasonally reversing, wind-driven, basin-scale gyre (Somayajulu, Murty, & Sarma, 2003). These conditions combine to produce a highly stratified and productive sea-surface layer that supports relatively large populations of Irrawaddy dolphins, finless porpoises, and Indo-Pacific humpback dolphins (Smith, et al., 2008). The first two species are Red Listed by the IUCN as 'vulnerable' and the third as 'near threatened.'
- A distance analysis of Irrawaddy dolphin and finless porpoise sightings made during a survey conducted in the winter season of 2004 resulted in abundance estimates of 5,383 (CV=39.5) and 1,382 (CV=54.8%) individuals, respectively (Smith, et al., 2008). This is the largest documented population of Irrawaddy dolphins by more than an order of magnitude. Its large size can almost certainly be explained by the extensive freshwater influence of the GBM system. The population estimate for finless porpoises also compares favorably to other marine areas where the species has

been surveyed - e.g., Ariake Sound and Tachibana Bay (Yoshida, Shirakihara, Kishino, & Shirakihara, 1997) and Hong Kong and adjacent waters (Jefferson, Hung, Law, Torey, & Tregenza, 2002). Although an insufficient number of Indo-Pacific humpback dolphin groups were observed during the 2004 survey to estimate abundance (*n*=6), the relatively large size of some groups (>50 individuals) probably indicates a significant population.

- During the 2004 survey mentioned above all three species were found much farther offshore compared to other areas of their distribution (>30 nm for Irrawaddy dolphin, >36 nm for finless porpoise, and >19 nm for Indo-Pacific humpback dolphins) even though the survey was conducted in the winter when freshwater discharge was at its lowest. Habitat selection models for Irrawaddy dolphins indicate that the species would almost certainly be found even farther offshore with increasing freshwater flow during the monsoon season (Smith, et al., 2008).
- The Swatch-of-No-Ground (SoNG) is a 900+ meter deep submarine canyon that incises approximately 65 nm inside the continental shelf in a northeast direction to within 20 nm of the rim of the Sundarbans mangrove forest. The canyon has relatively steep walls (12-15°), ranges from about 40 km wide at its mouth to about 6 km wide at its head, and carries sediments that sustain the world's largest submarine fan (Michels, Suckow, Breitzke, Kudrass, & Kottke, 2003; Subrahmanyam, Krishna, Ramana, & Murthy, 2008). According to a mark-resight analysis under Pollock's robust design of 907 individuals photo-identified during the winter seasons of 2005-2007, a population of about 1,800 Indo-Pacific bottlenose dolphins was estimated to occur in a 2,455 km^2 area at the head of the SoNG (Mansur *et al.* in review). This makes it one of the largest populations assessed of the species. The probability of animals transitioning from an observable state in season 1 to an unobservable state in season 2 was 15.2% or less which may indicate that the actual size of the population is higher than the estimate of 1,800 individuals (Mansur *et al.* in review).
- During the photo-identification study of Indo-Pacific bottlenose dolphins mentioned above eight sightings were made of pantropical spotted dolphins (mean group size = 137, range 20-350) in the far offshore fringes of the study area in waters >100 m deep (Brian D. Smith and Rubaiyat Mansur, unpublished). A single pantropical spotted dolphin group (~800 individuals) was also detected during the 2004 survey of coastal cetaceans at the far offshore and high salinity extreme of survey coverage (Smith, et al., 2008),which only touched the margin of the species' preferred habitat in warm, stratified, pelagic waters see (Perrin & Hohn, 1994). This implies that significant numbers of the species may also occur farther offshore in un-surveyed waters where stratification remains high due to the basin-scale current gyre in the Bay of Bengal (Smith, et al., 2008). During the same the photo-identification study, 14 sightings were made of spinner dolphins (mean group size = 85.0, SD=74.2, range = 2-200) in waters at the outer fringes of the study area >120 m deep (Brian D. Smith and Rubaiyat Mansur, unpublished).
- During 2005-2008, 114 sightings were made of Bryde's whales (mean groups size = 2.3, SD=2.0, range=1-15) in similar habitat as Indo-Pacific bottlenose dolphins at the head of the SoNG (Brian D. Smith and Rubaiyat Mansur, unpublished). A total of 15 individuals were identified from photographs of their dorsal fin, of which six were re-identified during all three seasons (Mahabub, 2008). MtDNA control region data from 38 skin samples collected from these whales indicated that these animals were closely aligned with the "small form" of Bryde's whales (Matt Leslie, unpublished). Bryde's whales are not known to undergo long-range seasonal migrations and the high, predictable productivity in the SoNG may support a resident population of this species. The common occurrence of calves may also indicate that the area is important for breeding
- Although there are no empirical data on the abundance of cetaceans inhabiting the coastal or deep-sea waters on the Indian side of the border of the proposed Offshore Biologically Important Area, similar high densities of cetaceans may be inferred from the existence of similar habitat including freshwater discharge from the Sundarbans and Hooghly River and at western edge of the SoNG.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	0	0	0	1	2	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	2	0	0	4
Status	Not Eligible	Eligible	Eligible	N/A	N/A	Eligible
Assessment	Insufficient Detail	Requires More Data	Requires More Data	N/A	N/A	Strong Justification

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

IUCN Marine Region 12: East Africa

Coastal Waters off Madagascar (Madagascar)

Potential Criteria:	2A: High Density 2B: Breeding and Calving Grounds 2B: Foraging Grounds 2B: Migratory Route 2B: Critical Habitat
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) Blue whale (*Balaenoptera musculus*) Sperm whale (*Physeter macrocephalus*) Beaked whales (family Ziphiidae) Bottlenose dolphins (*Tursiops aduncus, T. 169runcates*) Indo-Pacific Humpback dolphin (*Sousa chinensis*) Melon-headed whale (*Peponocephala electra*)
Proposed Boundary Consideration: *Basis: H. Rosenbaum. Published literature, IWC reports and Wildlife Conservation Society unpublished data.*	All coasts of Madagascar out to 50 nm. **NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- Well documented breeding habitat for humpback whales, with particularly good documentation of dense aggregations in the northeast (Antongil Bay, Isle Ste. Marie), the southeast (Ft. Dauphin), southwest regions (Toliara/Anakao), the Comoros Archipelago off the northeast coast, and suggestions of distribution throughout the entire region (Cerchio, Andrianarivelo, Razafindrakoto, Mendez, & Rosenbaum, 2009; Cerchio et al., 2009; Ersts & Rosenbaum, 2003; Rosenbaum, et al., 2009; Rosenbaum, Walsh, Razafindrakoto, Vely, & Desalle, 1997).
- Presence of sperm whales and beaked whales documented in waters off shelf in the northeast, southwest and northwest regions (Kiszka et al., 2009; Townsend, 1935). Likely foraging grounds in these deep waters.
- Sensitive populations of coastal dolphins, including impacted populations of humpback dolphins, bottlenose dolphins and spinner dolphins off the west coast (Cerchio, Andrianarivelo, et al., 2009). Clearly foraging and breeding habitat for all these non-migratory species.
- High biodiversity documented in the southwest region with 13 different cetacean species due to the close proximity of foraging habitat suitable for both inshore, shallow water species and offshore, deep water species (Cerchio, Andrianarivelo, et al., 2009).
- Documented mass stranding of melon-headed whales off the northeast coast associated with oil and gas exploration activities and the introduction of noise into the regional waters.
- Likely migratory routes for blue whales in the offshore waters off both the east coast and west coast (Mozambique Channel) (Branch, et al., 2007).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
5	3	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	2	4	3	0	0
Status	Not Eligible	Eligible	Eligible	Eligible	N/A	N/A
Assessment	Insufficient Detail	Requires More Data	Strong Justification	Adequate Justification	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Madagascar Plateau / Madagascar Ridge / Walters Shoal (Madagascar)

Potential Criteria:	2A: High Density 2B: Foraging Grounds 2B: Migratory Route 2C: Small Distinct Population
Species of Concern:	Pygmy Blue Whale (*Balaenoptera musculus brevicauda*) Humpback Whale (*Megaptera novaeangliae*) Brydes Whale (*Balaenoptera edeni*)
Proposed Boundary Consideration: Location inferred from Best et al. (2003), Branch et al. (2007)	Approximately 25ºS to 40ºS and 40ºE to 55ºE ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- Historic concentrations of catch records of blue whales, likely pygmy blue whale sub-species (Branch, et al., 2007).
- Currently, best documented congregation and feeding area for a pygmy blue whale population in the Indian Ocean, with abundance estimated by line transect distance-sampling at 424 individuals (CV = 0.42) (Best et al., 2003).
- Population identity is likely one of three suspected populations of pygmy blue whales in the Indian Ocean, characterized acoustically by stereotyped "Madagascar" call type (Branch, et al., 2007; McDonald, Mesnick, & Hildebrand, 2006), and restricted to the larger southwest Indian Ocean region (though range extent is currently unknown).
- Documented feeding area and migratory route / stopping area for southwest Indian Ocean population of Humpback whales, Breeding Stock C (Best et al., 1998).
- Documented concentrations of Bryde's whales, they are believed to represent a stock/population/subspecies distinct from two coastal African populations (Best, 2001).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
5	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	3	4	3	0	2
Status	Not Eligible	Eligible	Eligible	Eligible	N/A	Eligible
Assessment	Insufficient Detail	Adequate Justification	Strong Justification	Adequate Justification	N/A	Requires More Data

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

IUCN Marine Region 13: East Asia

Gulf of Thailand (Thailand, Malaysia, Cambodia)

Potential Criteria:	2A: High Density 2B: Breeding / Calving 2B: Critical Habitat 2C: Small Distinct Population
Species of Concern:	Indo-Pacific humpback dolphin (*Sousa chinensis*) Irrawaddy dolphin (*Orcaella brevirostris*) Finless porpoise (*Neophocaena phocaenoides)*
Proposed Boundary Consideration: *Basis: T. Jefferson*	SME did not submit a spatial file. **NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The Gulf of Thailand is an area of concentration for three species of coastal small cetaceans that are threatened by human activities: the Indo-Pacific humpback dolphin, Irrawaddy dolphin, and finless porpoise.
- These populations are under stress from serious habitat alteration and unregulated captures for live-display (Beasley, Davidson, Somany, & Ath, 2002; Mahakunlayanakul, 1996).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	1	1	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	1	0	0	3
Status	Not Eligible	N/A	Not Eligible	N/A	N/A	Eligible
Assessment	Insufficient Detail	N/A	Insufficient Detail	N/A	N/A	Adequate Justification

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
0	SME did not provide boundary information.

Komodo National Park, Biosphere Reserve (Indonesia)

Potential Criteria:	2A: High Density
Species of Concern:	Omura's whale (*Balaenoptera omurai*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	SME did not submit a spatial file. *Note that some areas are within 12 nm of coastline.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The waters around Komodo Island have been found to contain significant numbers of Omura's whales (*Balaenoptera omurai*). This is a newly-recognized species of baleen whale, which has been subjected to whaling operations by Japan, and currently is of unknown status (Kahn, 2001; Kahn, Wawandono, & Subijanto, 2001).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	2	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
0	SME did not provide boundary information.

Area in the Ombai Strait in the Savu Sea Marine Protected Area (Indonesia)

Potential Criteria:	2B: Migration Route 2B: Feeding Grounds
Species of Concern:	Blue Whale (*Balaenoptera musculus*) Sperm whale (*Physeter macrocephalus*)
Proposed Boundary Consideration: Location inferred from Pet Soede (2002)	124°19'2.12"E, 8°40'3.814"S 125°0'5.731"E, 8°32'35.885"S 124°49'57.827"E, 8°46'59.748"S 124°26'46.047"E, 8°57'55.645"S *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	June through September

Background

- The Indonesian Marine Affairs and Fisheries Minister Freddy Numberi announced the designation of the Savu Sea National Marine Park—a blue whale hotspot, in May 2009.
- There is little species information on this area. However, The Nature Conservancy has sponsored the Solor-Alor Visual and Acoustic Cetacean Survey & Research Program in this area since 2001. Their studies consider the southeastern cape of Alor and the entrance of Ombai Strait, is considered to be a wide and important migratory corridor between Alor and East Timor (Pet-Soede, 2002).
- Initial comparisons between blue whale sightings south of Alor (Savu Sea) and north of Komodo (Flores Sea) suggests that blue whales enter and exit Indonesian Seas through different routes and corridors; perhaps initially migrating east towards Ombai Strait, between E. Alor and Timor, and then move into the Banda Sea (Pet-Soede, 2002).
- The small passages between the Solor-Alor Islands in the Savu Sea are considered feeding grounds and corridors for cetacean migration (Mustika, 2006).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	1	1	1

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	2	0	2	0	0
Status	N/A	Eligible	N/A	Eligible	N/A	N/A
Assessment	N/A	Requires More Data	N/A	Requires More Data	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

IUCN Marine Region 15: Northeast Pacific

Beaked Whale Habitat in the Coastal Waters off California, Washington, and Oregon (United States)

Potential Criteria:	2A: High Density 2B: Critical Habitat
Species of Concern:	Beaked whales (*Ziphiidae*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	Bathymetry: Between 550 and 2,000 meter depth contours. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited MacLeod and Mitchell (2005) for support.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	Not Eligible	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	Does not qualify.	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Central California National Marine Sanctuaries (United States)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Migration Route
Species of Concern:	Blue whale (*Balaenoptera musculus*) Humpback whale (*Megaptera novaeangliae*) Dall's porpoise (*Phocoenoides dalli*) Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) Northern right whale dolphin (*Lissodelphis borealis*) Risso's dolphin (*Grampus griseus*) Eastern gray whale (*Eschrichtius robustus*) Steller sea lion (*Eumetopias jubatus*)
Proposed Boundary Consideration: Location inferred from Forney (2007)	Single stratum boundary created from the Cordell Bank, Gulf of the Farallones, and Monterey Bay legal boundaries.
Proposed Temporal Consideration:	Blue and humpback whale feeding in this area is largely limited to June-November. Gray whales migrate through this area December-May but are likely to be greater than 12 miles from shore only when crossing Monterey Bay. All other species are year-round residents.

Background Provided by SME

- During the summer and fall of 2005, the Southwest Fisheries Science Center conducted a shipboard line-transect survey of marine mammals in the waters off California, Oregon, and Washington out to 300 nm, with fine-scale survey effort in four National Marine Sanctuaries (NMSs), namely the Olympic Coast, Cordell Bank, Gulf of the Farallones, and Monterey Bay NMSs (Forney, 2007). Geographically-stratified line-transect analyses were used to derive density and abundance estimates for three strata with coarse survey coverage (southern California, central and northern California combined, and Oregon and Washington combined) and three strata with fine-scale survey coverage (the Olympic Coast slope, Olympic Coast NMS, and the three central California NMSs combined). Based on the stratified line-transect analyses, the densities in the central California NMS stratum were the highest among all geographic strata for five cetacean species, Dall's porpoise, northern right whale dolphins, Risso's dolphins, humpback whales, and blue whales. Furthermore, the density of Pacific white-sided dolphins in the central California NMS stratum was the second highest among all strata.
- Each fall, gray whales migrate south along the coast of North America from Alaska to Baja California, in Mexico, most of them starting in November or December (Rugh, Shelden, & Schulman-Janiger, 2001). Gray whale northbound migration generally begins in mid-February and continues through May with cows and newborn calves migrating northward primarily between March and June along the U.S. West Coast (Carretta et al., 2008). Gray whales are greater than 12 nm from shore when they migrate across the mouth of Monterey Bay.
- In the Monterey Bay, blue whales feed on dense euphausiid aggregations between 150 and 200 m on the edge of the Monterey Bay Submarine Canyon. (Croll et al., 2005). Blue whale feeding is also particularly common from the Cordell Bank shoreward to Bodega Bay (Barlow & Forney, 2007) and at the southern extent of the Monterey Bay National Marine Sanctuary (Barlow & Forney, 2007).
- Humpback whale feeding is particularly concentrated with the Cordell Bank, Gulf of the Farallon and Monterey Bay National Marine Sanctuaries (Barlow & Forney, 2007; Forney, 2007).

- The cyclic annual migration of the northeastern Pacific blue whale population is associated with feeding at mid- to high-latitudes throughout the highly productive summer and fall, followed by a southbound migration to tropical regions to give birth and mate in the winter and spring. Primary production off southern California typically peaks in the spring allowing particular euphausiid species to grow to maturity by summer, coinciding with the arrival of blue whales (Burtenshaw et al., 2004).
- Cordell Bank is located about 80 kilometers (50 miles) northwest of San Francisco and 32 kilometers west of the Point Reyes lighthouse. It is approximately 7 kilometers wide and 15 kilometers long and sits on the edge of the continental shelf. The bank is located on the edge of an underwater peninsula and is surrounded by deep water on three sides. Within 11 kilometers of its western edge, the seafloor drops to 1,829 meters at the sanctuary's western boundary (NMS, 2009a).
- Vertical entrapment and/or forcing of prey near the surface likely plays a role in predator aggregation over Cordell Bank. Also, Cordell Bank is shallower than the diurnal depth range of many zooplankton species, especially euphausiids and could vertically trap these prey species in shallow regions within the diving depth of many predators (Yen, Sydeman, & Hyrenbach, 2004)
- Northern fur seals and California sea lions are seasonally abundant in the Cordell Bank NMS, coming here to forage during the fall through the spring.
- Since 1982 Steller sea lion southernmost breeding colonies are within the Monterey Bay and Gulf of the Farallones National Marine Sanctuaries at Año Nuevo Island and the Farallon Islands, respectively. Females and juveniles Steller sea lions stay within the Gulf year-round, while males migrate north and offshore during the non-breeding season from the end of August through May (NMS, 2009c).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
7	0	0	0	2	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	4	4	0	4	0	0
Status	Eligible	Eligible	N/A	Eligible	N/A	N/A
Assessment	Strong Justification	Strong Justification	N/A	Strong Justification	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed .

Vaquita Habitat in the Northern Gulf of California (Mexico)

Potential Criteria:	2C: Small, Distinct Population with Limited Distribution
Species of Concern:	vaquita (*Phocoena sinus*)
Proposed Boundary Consideration: Location inferred from PACE recovery plan	All of the waters in the Gulf of California located north of the line defined by the following coordinates: 114°42'00"W, 30°36'00"N 113°33'00"W, 31°18'54"N
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- The vaquita (also known as the Gulf of California harbor porpoise) is listed as Critically Endangered by the IUCN and as Endangered by both the Mexican Official Standard NOM-059 and the U.S. Endangered Species Act.
- A 2007 abundance estimate suggested that only about 150 individuals remained in the population (Jaramillo-Legorreta et al., 2007), and recent acoustic surveys indicate that the population is currently declining rapidly (Jaramillo-Legorreta & Rojas-Bracho, 2008).
- The range of the vaquita population is very small, limited to the northern Gulf of California (Jaramillo-Legorreta, Rojas-Bracho, & Gerrodette, 1999).
- Vaquitas are occasionally found more than 12 nm from shore.
- The primary and ongoing threat to the vaquita is mortality resulting from bycatch in commercial and artisanal gillnet fisheries for shrimp and fish (CIRVA, 1997, 1999, 2004; Rojas-Bracho & Taylor, 1999).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	3	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	0	0	0	4
Status	N/A	N/A	N/A	N/A	N/A	Eligible
Assessment	N/A	N/A	N/A	N/A	N/A	Strong Justification

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed .

Southern Gulf of California (Mexico)

Potential Criteria:	2A: High Density
Species of Concern:	Cuvier's beaked whale (*Ziphius cavirostris*) Blainville's beaked whale(*Mesoplodon densirostris*) Peruvian beaked whale (*Mesoplodon peruvianus*) Sperm whales (*Physeter macrocephalus*) Coastal spotted dolphin (*Stenella attenuate graffmani*) Long-beaked common dolphin (*Delphinus delphis*) Bottlenose dolphins (*Tursiops truncatus*) Risso's dolphin (*Grampus griseus*) Short-finned pilot whale (*Globicephala macrorhynchus*) Dwarf sperm whale (*Kogia sima*) Bryde's whale (*Balaenoptera edeni*) Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: Location inferred from references cetacean and oceanographic cited in Background material	All of the waters in the southern Gulf of California between 22.88 ^{o}N and 30^{o}N ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically designated area of biological importance.*
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- The southern Gulf of California is an area of particularly high population density for Cuvier's and *Mesoplodon* beaked whales, sperm whales, Bryde's whales, fin whales, coastal spotted dolphins, long-beaked common dolphins, bottlenose dolphins, Risso's dolphins, short-finned pilot whales, and dwarf sperm whales, based on two different analytical methods, geographically stratified line-transect analyses (Ferguson & Barlow, 2001, 2003) and cetacean-habitat models (Ferguson, Barlow, Fiedler, Reilly, & Gerrodette, 2006; Ferguson, Barlow, Reilly, & Gerrodette, 2006). Data for both analyses were based on cetacean sighting data from shipboard line-transect surveys conducted by the Southwest Fisheries Science Center that were designed to study the distribution and abundance of cetaceans.
- The Gulf of California is a narrow sea, with considerable habitat diversity from the northern to the southern end of the Gulf. The Midriff Islands, located between 28^{o}-30^{o} N, separate the shallow (approximately 120 m) northern Gulf from the deep (approximately 2000 m) basin of the southern Gulf (Gutiérrez, Marinone, & Parés-Sierra, 2004).
- Basin-wide eddies that reliably form between the Midriff Islands and the mouth of the Gulf enhances productivity in this region of the Gulf (Pegau, Boss, & Martínez, 2002).
- The northern Gulf (north of approximately 29^{o} N) is characterized by a large-scale, seasonally-reversing gyre (Beier & Ripa, 1999; Carrillo & Palacios-Hernandez, 2002). Collectively, this oceanographic evidence supports placing the boundary between ecosystems in the southern and northern Gulf at approximately 30^{o}N.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Southern California Bight (United States)

Potential Criteria:	2B: Foraging Area 2B: Migration Route
Species of Concern:	Pacific gray whale (*Eschrichtius robustus*) Blue whale (*Balaenoptera musculus*) Short-beaked common dolphin (*Delphinus delphis*) Long-beaked common dolphin (*Delphinus capensis*) Risso's dolphins (*Grampus griseus*)
Proposed Boundary Consideration: Location inferred from Barlow et al. (2009)	120.5°W, 34.5°N to120.5°W, 32°N to 118.605°W, 31.1318°N to 117.8253°W, 32.6269°N to 117.4637°W, 32.5895°N to 117.121°W, 32.507°N
Proposed Temporal Consideration:	Jun through Nov for blue whales, Dec through May for gray whales, year-round for all other species

Background Provided by SME

- The Southern California Bight is a high-density feeding area for a wide variety of cetacean species. The most abundant species is the short-beaked common dolphin, *Delphinus delphis*. The boundaries of this area are taken approximately as the area where *D. delphis* density is estimated to be over 1 animal per km-2 (Barlow et al., 2009). High density areas for other species listed above fall within this zone.
- The waters around the Channel Islands within the Southern California Bight have particularly high densities of Risso's dolphins (Barlow et al. 2009) and long-beaked common dolphins (Barlow & Forney, 2007).
- For blue whales, feeding was noted at a significant fraction of blue whale sightings over the shelf (out to 3.5 km beyond the 200 m isobath) in three areas: around Santa Rosa and San Miguel Islands, north of San Nicolas Island, and along the mainland coast from Pt. Conception north (Fiedler et al., 1998)
- The results of the Whale Habitat and Prey Studies (WHAPS) show that blue whales aggregated near the Channel Islands during the summer, where they feed on dense patches of krill associated with the island shelf. Krill were most abundant along the shelf on the north and west sides of San Miguel Island and the north side of Santa Rosa Island (Fiedler, et al., 1998).
- Blue whales feed off the California coast from roughly June through November, and move southward to waters off Mexico in winter and spring (Calambokidis et al., 1990).
- A study on visual and acoustic encounter rates for blue whales in the SAB reported elevated detection rates of in the Cortez Bank and Butterfly Bank subregions, as the dynamic bathymetry in those regions may concentrate high densities of euphausiids (Oleson, Calambokidis, Barlow, & Hildebrand, 2007). Oleson et al. also notes that the similarity in the visual and acoustic encounter rates in the Cortez Bank and Butterfly Bank subregions suggests that these areas may represent portions of the Bight important to both feeding and traveling whales.
- Each fall, gray whales migrate south along the coast of North America from Alaska to Baja California, in Mexico, most of them starting in November or December (Rugh, et al., 2001). Gray whale northbound migration generally begins in mid-February and continues through May with cows and newborn calves migrating northward primarily between March and June along the U.S. West Coast (Carretta, et al., 2008). Although some gray whales follow the coast in Southern California, many or most are greater than 12 nm from shore when they migrate across the Southern California Bight.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
9	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	4	0	4	0	0
Status	N/A	Eligible	N/A	Eligible	N/A	N/A
Assessment	N/A	Strong Justification	N/A	Strong Justification	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance. .

Fairweather Grounds, Southeast Alaska (United States)

Potential Criterion:	2B: Foraging Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration: *Basis: NMFS West Coast*	Bounded by 58° 10'N and 58° 30'N, 137° 30'W, and 139° 10'W
Proposed Temporal Consideration:	June through September

Background Provided by SME

- The Fairweather Grounds, located offshore of Mount Fairweather in the Gulf of Alaska, is an offshore bump in the continental shelf waters off Southeast Alaska, rising to within 50 m of the surface. This bathymetric relief provides an area of concentration for fish and zooplankton food sources for humpback whales.
- The bank is more than 12 nm offshore.
- The Fairweather Grounds has long been recognized as a rich whaling ground (Davidson 1869, Coast Pilot of Alaska, US Govt. Printing Office, Washington D.C.). In that report, the area was described as being from Pamploma Reef eastward to the shores off of Mount Fairweather.
- A recent NOAA survey in 2004 found dense groups of humpback whales feeding in the same area, between 58° 10'N and 58°30'N and between 137°30'W and 139° 10'W, with super-groups of 16, 20, and 25 whales (J. Barlow, pers. comm).
- Local fishermen from Sitka often report seeing whales in the Fairweather Grounds (J. Straley, pers. comm.).
- Most of the Fairweather Grounds is more than 12 nm from shore and thus would be considered an offshore biologically important area for feeding humpback whales.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	2	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	2	0	0	0	0
Status	N/A	Eligible	N/A	N/A	N/A	N/A
Assessment	N/A	Requires More Data	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Olympic Coast: The Prairie, Barkley Canyon, and Nitnat Canyon (Washington)

Potential Criterion:	2B: Foraging Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) Killer whale (*Orcinus orca*)
Proposed Boundary Consideration: Location inferred from Calambokidis et al. (2004)	125°58'38.786"W, 48°30'1.995"N to 125°38'52.052"W, 48°16'55.605"N to 125°17'10.935"W, 48°23'7.353"N to 125°16'42.339"W, 48°12'38.241"N to 125°31'14.517"W, 47°58'20.361"N to 126°6'16.322"W, 47°58'20.361"N to 126°25'48.758"W, 48°9'46.665"N *and existing OBIA boundary as defined in the 2007 Rule.*
Proposed Seasonal Consideration:	June through September

Background

- A CSCAPE survey reported that humpback whale sightings were concentrated in the northern part of the study area between Juan de Fuca Canyon and the outer edge of the continental shelf, an area known as "the Prairie" (Fig. 2). A small area east of the mouth of Barkley Canyon and north of the Nitnat Canyon where the water depth was 125−145 m had a high density of sightings in all years (Calambokidis, Steiger, Ellifrit, Troutman, & Bowlby, 2004). http://www.cascadiaresearch.org/reports/Fish-bul-OCSwEratum.pdf
- NOAA Technical Memorandum 406 estimated that the abundance of humpback whales within the combined three OC strata during 2005 (208, CV=0.28) was about twice the observed abundance during 1995-2000 (range of abundance estimates: 85 - 125, CVs ~0.32), but lower than the peak year of 2002 with 562 (CV=0.21) humpback whales.
- NOAA Technical Memorandum 406 reports that humpback whales were observed largely in the same areas of the OCNMS as during previous years and noted that regions within and to the north (Canadian waters) and west (slope waters) of the OCNMS were likely important foraging regions for West Coast humpback whales.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	2	0	0	0	0
Status	N/A	Eligible	N/A	N/A	N/A	N/A
Assessment	N/A	Requires More Data	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Gulf of Alaska Steller Sea Lion Critical Habitat (Alaska)

Potential Criterion:	2B: Designated Critical Habitat
Species of Concern:	Steller sea lion (*Eumetopias jubatus*)
Proposed Boundary Consideration: Basis: U.S. Government	Critical habitat includes an aquatic zone that extends 20 nm (37 km) seaward in State and Federally-managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is west of 144°W longitude. 145°43'7.708"W, 60°17'41.42"N to 143°37'31.682"W, 59°38'59.715"N to 146°26'15.838"W, 59°6'38.618"N to 147°34'46.397"W, 59°30'6.865"N to 150°15'53.824"W, 58°57'45.767"N to 151°45'20.388"W, 57°8'1.26"N to 155°30'50.98"W, 55°26'1.094"N to 159°22'19.342"W, 54°24'29.203"N to 162°43'58.85"W, 53°54'32.736"N to 163°23'18.616"W, 54°12'18.436"N to 172°57'38.806"W, 51°40'49.533"N to 179°25'44.364"W, 50°49'26.613"N to 179°39'3.639"W, 51°6'34.253"N to 163°49'34.33"W, 54°21'56.96"N to 157°56'22.112"W, 56°20'3.869"N to 153°11'13.812"W, 58°25'39.894"N to 148°41'53.223"W, 59°49'8.687"N to 148°2'52.488"W, 59°38'59.715"N
Proposed Seasonal Consideration:	Year-Round

Background

- NMFS has designated critical habitat for the Steller sea lion in certain areas and waters of Alaska. Steller sea lions are dependent on these areas and features for its continued existence and any Federal action that may affect these areas or features is subject to the consultation requirements of section 7 of the ESA 58 (58 Federal Register 45269-45285, August 27, 1993).
- Critical habitat includes an aquatic zone that extends 3,000 feet (0.9 km) seaward in State- and Federally-managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is east of 144°W longitude. Critical habitat includes an aquatic zone that extends 20 nm (37 km) seaward in State and Federally-managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is west of 144°W longitude.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	0	0	4	0
Status	N/A	N/A	N/A	N/A	Eligible	N/A
Assessment	N/A	N/A	N/A	N/A	Strong Justification	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

Piltun and Chayvo Offshore Feeding Grounds (Russia)

Potential Criteria:	2B: Migration Route 2B: Foraging Area
Species of Concern:	Western Pacific gray whale (*Eschrichtius robustus*)
Proposed Boundary Consideration: Location inferred from IWC and Tyurneva (2006)	143°33'26.5"E, 53°30'42.938"N to 143°40'42.039"E, 53°34'13.683"N to 143°48'39.728"E, 52°41'4.409"N to 143°51'56.423"E, 52°1'44.066"N to 143°24'32.613"E, 52°2'54.314"N to 143°40'13.94"E, 52°38'43.912"N to 143°33'26.5", 53°30'42.938"N
Proposed Seasonal Consideration:	June through November

Background

- The critically endangered western gray whale spends the summer-fall open water period feeding off northeast Sakhalin Island (Rutenko, Borisov, Gritsenko, & Jenkerson, 2007). A previously unknown gray whale feeding area (the Offshore feeding area) was discovered south and offshore from the nearshore Piltun feeding area. The Offshore area has subsequently been shown to be used by feeding gray whales during several years when no anthropogenic activity occurred near the Piltun feeding area (S. Johnson et al., 2007).
- Results of a 2001-2003 aerial survey of the area indicated that gray whales occurred in predominantly two areas, (1) adjacent to Piltun Bay, and (2) offshore from Chayvo Bay (offshore feeding areas). In the Piltun feeding area, the majority of whales were observed in waters shallower than 20 m and were distributed from several hundred meters to similar to 5 km from the shoreline. In the offshore feeding area during all years, the distribution of gray whales extended from southwest to northeast in waters 30-65 m in depth. Fluctuations in the number of whales observed within the Piltun and offshore feeding areas and few sightings outside of these two areas indicate that gray whales move between the Piltun and offshore feeding areas during their summer-fall feeding season. Seasonal shifts in the distribution and abundance of gray whales between and within both the Piltun and offshore feeding areas are thought, in part, to be a response to seasonal changes in the distribution and abundance of prey (Meier et al., 2007).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	3	0	1	0	0
Status	N/A	Eligible	N/A	Not Eligible	N/A	N/A
Assessment	N/A	Adequate Justification	N/A	Insufficient Detail	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

IUCN Marine Region 16: Northwest Pacific

Okhotsk Sea (Russia)

Potential Criteria:	2B: Foraging Area 2B: Migration Route
Species of Concern:	Fin whale (*Balaenoptera physalus*) Minke whale (*Balaenoptera acutorostrata*) North Pacific Humpback whale (*Megaptera novaeangliae*) Western Pacific Right whale (*Eubalaena japonica*) Okhotsk Sea bowhead whale (*Balaena mysticetus*) Baird's beaked whale (*Berardius bairdii*) Dall's porpoise (*Phocoenoides dalli*)
Proposed Boundary Consideration: *Basis: NMFS West Coast*	SME did not submit a spatial file. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- A separate population of bowhead whales is restricted to the Okhotsk Sea. During the late spring and early summer these whales concentrate in Shelikhov Bay in the northeastern Okhotsk Sea and then are found from May to October in the Shantar region of the northwestern Okhotsk Sea. However, little is known about their winter distribution, but these whales do not leave the Okhotsk Sea. These concentrations are found within the 12 nm of the coast. The population is estimated in the low hundreds, but this is not based on any quantitative analysis.
- The western population of right whales summers and feeds in the Okhotsk Sea mainly off southern Sakhalin Island and the western side of the Kamchatka Peninsula. The population was depleted during 19th century whaling and again by Soviet whaling in the 1960s. Based on summer sightings during a Japanese-Russian surveys in the Okhotsk Sea in Miyashita and Kato (1998) derived a population estimate of 922 whales (95% CI 404-2,108) using line transect analysis.
- Fin whales seem to be abundant in the central offshore part of the Okhotsk Sea based on recent Japanese surveys, but no abundance estimate has been calculated (Miyashita, 2004).
- A joint Japanese-Russian surveys in the summers of 1989 and 1990 yielded an abundance estimate for western North Pacific minke whales of 25,049 (CV 0.316), but most of these whales (19,209; CV 0.339) were found in the Okhotsk Sea (Buckland, Cattanach, & Miyashita, 1992). The Okhotsk Sea has been surveyed again in 2003 (Miyashita, 2004), but no updated abundance estimate has been derived.
- The main summer feeding grounds for the western North Pacific humpback whales are the waters off easternmost Russian, including the western Bering Sea, the Okhotsk Sea, south to the Sanriku coast of Honshu, Japan (Rice, 1998) [plus any new SPLASH data population estimate of ca. 1,000 whales]).
- Three species of beaked whales (*Z. cavirostris*, *B. bairdii*, and *M. steinegeri*) are known from the waters of the Russian Far East (Tomilin, 1967). The first stranding of a Cuvier's beaked whale was in 1882 from Bering Island, Commander Islands and this specimen is the holotype of *Ziphius grebnitzkii* (Stejneger 1883). Most of the strandings for these species are from the Commander Islands where Cuvier's beaked whale is the most frequently found (Tomilin, 1967).

- Dall's porpoise are recognized as two different color type: the dalli-type and the truei-type. Based on 2003 survey data the population estimates for dalli-type and truei-type porpoises are 173,638 and 178,157, respectively (GOJ, 2007). The true-type breed in the central part of the Okhotsk Sea in summer.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
7	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	4	0	2	0	0
Status	N/A	Eligible	N/A	Eligible	N/A	N/A
Assessment	N/A	Strong Justification	N/A	Requires More Data	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
0	SME did not provide boundary information.

Exclusion around Japan and the Ryukyu Islands (Japan)

Potential Criteria:	SME did not submit criteria. (NMFS West Coast) 2A: High Density (TJ) 2B: Critical Habitat (TJ)
Species of Concern:	At least 39 species of cetaceans, including eight species of baleen whales, seven species of beaked whales are known from Japanese waters. Beaked whales (*Ziphiidae*) (TJ)
Proposed Boundary Consideration: *Basis: NMFS West Coast or T. Jefferson*	Exclusion around the main Japanese Islands and Ryukyu Islands, extending 100 km (54 nm) seaward of the 12 nm border along the Pacific side (eastern coastline of Japan) and extending 100 km on both sides of the Ryukyu Islands (Okinawa, Kerama, Miiyako, Yaeyama, Kume, Iriomote, and Ishigaki). Bathymetry: between 550 and 2,000 meter depth contours. (TJ) **NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The Japanese Archipelago is the world's seventh largest island. The waters around the Japanese Islands have a large diversity of cetaceans because of a distant cool-temperate and warm-temperate fauna to the north and to the south, respectively. The cold water along the northern half of Japan is from the Oyashio Current which supports the Oyashio Large Marine Ecosystem (OLME). The OLME is one of the most productive ecosystems in the North Pacific Ocean (Minoda, 1989). Along the southern half of Japan warmer waters are found from the Kuroshio Current which supports the Kuroshio Large Marine Ecosystem and extends south to its origin off the Philippines.
- At least 39 species of cetaceans are found within these two large marine ecosystems in the Japanese EEZ, including many ecologically and genetically distinct populations. (e.g., (Fujino, 1960; Hayano, 2004, 2007; Ichihara, 1957b; Kasuya & Miyashita, 1988, 1997; Kasuya, Miyashita, & Kasamatsu, 1988; Kasuya & Tai, 1993; Kato, 1992; Miyazaki & Amano, 1994; Miyazaki & Nakayama, 1989; Wada, 1988).
- Eight species of baleen whales (fin whales, sei whales, minke whales, Bryde's whales, Omura's whales, humpback whales, gray whales and North Pacific right whales) are known from Japanese waters.
- In the western North Pacific, there are at least two distinct populations of minke whale. The "J stock" which appears to be an autumn-breeding population that occurs in the Yellow Sea, East China Sea and Sea of Japan. They also occur at least seasonally in the coastal waters along the Pacific coast of Japan with limited penetration into the Okhotsk Sea in summer; The other population is the "O-stock" which breeds in winter like most baleen whales, and occurs in summer in the northwestern Pacific including the northeastern coasts of Japan, and in the Okhotsk Sea, but the "J stock" with a with conception peak in the fall (Kato, 1992; Omura & Sakiura, 1956). J stock whales are found out to at least 50 nm from the Pacific coast of Japan. The population is considered delepted because of past commercial whaling and current bycatch in both Korean and Japanese waters.
- Seven species of beaked whales (*I. pacificus*, *B. bairdii*, *Z. cavirostris*, *M. carlhubbsi*, *M. densirostris*, *M. ginkodens*, *M. stejnegeri*) are known from Japanese waters. Longman's beaked whale was not

recorded until July 2002 at Sendai-shi, Kyushu (Yamada). Three of these species (*B. bairdii*, *M. carlhubbsi*, and *M. stejnegeri*) are restriched to the cold waters of the Oyashio Current and the others are found in the warm Kuroshio Current to the south of 35 N. Cuvier's beaked whales are found in all waters around Japan and six mass strandings (with three or more individuals) of these whales occurred in Sagami Bay and Suruga Bay between 1963 and 1990 (Brownell, Yamada, Mead, & Van Helden, 2004).

- Baird's beaked whales are found off the slope of the eastern coast of Japan to about 35 N. Vessel surveys were conducted between 1983 and 1991 and in 1992. These surveys produced Overall abundance estimates of 4,220 and 5,029, respectively (Miyashita, 1986; Miyashita & Kato, 1993). No abundance estimates are available for any of the other species of beaked whales in Japanese waters and little is known about these actual distributions except from stranded animals.
- Miyashita (1993) estimated population size of the northern form of the short-finned pilot whales in the cold water Oyashio Current off the NE coast of Japan, based on summer surveys in 1982 through 1988 was 4,239 (CV=0.61).
- Dall's porpoise are found only in the North Pacific and two forms are found in the west. These are the dalli-type found along the east side of Japan north of 35 N. and the truei-type known from northern Japan and southern half of the Okhotsk Sea. Based on 2003, abundance estimates for the dalli-type and truei-type were 173,638 and 178,157, respectively (GOJ, 2007). During the winter the truei-type are found in the Oyashio Current offshore from Choshi, Japan to Hokkiado, Japan but in the summer they move to the central Okhotsk Sea. The dalli-type spend the winter in the northern part of the Sea of Japan north of the Shimane Pref. and breed in the Okhotsk Sea.
- Miyashita (1993) estimated the population size of the northern form of the short-finned pilot whales in the cold water Oyashio Current off the NE coast of Japan, based on summer surveys in 1982 through 1988, was 4,239 (CV=0.61).
- Dall's porpoise are found only in the North Pacific and two forms are found in Japanese waters. These are the dalli-type found along the east side of Japan north of 35° N. and the truei-type known from northern Japan and the southern half of the Okhotsk Sea. Based on surveys in 2003, abundance estimates for the dalli-type and truei-type were 173,638 and 178,157, respectively (GOJ, 2007). During the winter the truei-type are found in the Oyashio Current offshore from Choshi, Japan to Hokkaido, Japan but in the summer they move to the central Okhotsk Sea. The dalli-type spends the winter in the northern part of the Sea of Japan (north of the Shimane Pref.) and breed in the Okhotsk Sea.
- Other small cetaceans found in the Oyashio Current include: short-beaked dolphins, striped dolphins, common bottlenose dolphins, Risso's dolphins, northern right whale dolphins, Pacific white-sided dolphins, false killer whales, and killer whales.
- Small cetaceans in the Kuroshio Current in Japanese waters south of 34° N are the tropical and warm-temperate species found worldwide in these types of waters. Some of the more abundant small cetaceans here include: striped dolphins, spotted dolphins, common bottlenose dolphins, Risso's dolphins, southern short-finned pilot whales, and false killer whales. These species are well studied off Japan because they are taken by the Japanese drive fishery. Based on Japanese sightings surveys from 1983 to 1991 in the waters off Japan, population estimates were made for these six species (Miyashita, 1993). These are summarized below:
- Striped dolphins were found in August and September in three geographic concentrations in waters between 25°N - 41°N and 135°E to 180°. The total population estimate for this area was 570,000 (CV=0.18).
- Spotted dolphins were found in August and September and most were concentrated north of 30°. The area surveyed was between 25ºN-38ºN and west of 180º. The total population estimate for the area was 438,000 (CV=0.17).

- Common bottlenose dolphins were found in August and September in waters between 30ºN - 42ºN and west to 160ºE. The total population estimate for the area was 168,000 (CV=0.26).
- Risso's dolphins were found in three concentrations in waters south of 40ºN and west of 180º but their southern boundary was not determined during the surveys. The total abundance estimate was 838,000 (CV=0.17).
- The population size for southern form of short-finned pilot whales was estimated at 53,000 (CV=0.22) during the months of August and September in coastal and offshore waters west to 165ºE and between 25ºN - 36ºN.
- False killer whales were found in generally the same area as the short-finned pilot whales but their northern limit was more southern at 39ºN. The total abundance estimate was 16,000 (CV=0.26).
- Other small cetaceans found in the Kuroshio Current include the following: long-beaked common dolphins, pygmy killer whale, Fraser's dolphins, killer whales, melon-headed whales, spinner dolphins and rough-toothed dolphins.
- The melon-headed whales is known from nine mass stranding events in Japanese waters south of 36° N between 1982 and 2006 (Brownell, Yamada, Mead, & Allen, 2006).
- Also, the Indo-Pacific bottlenose dolphin is found in small seven discontinuous, isolated populations, within the main Japanese islands and offshore islands, in the Kuroshio Current. These populations are: (1) in the Bungo Channel, Amakusa (Shirakihara, Shirakihara, Tomonaga, & Takatsuki, 2002) (2) Kagoshima Bay (Nanbu, Hirose, Kubo, Kishiro, & Shinomiya, 2006) (3) in the Sea of Japan, around Noto-jima (Mori, 2005) (Mori and Yoshioka 2009), (4) Mikura Island and (6) Ogasawara Islands (Mori *et al*. 2005). Mikura and Ogasawara are about 200 km and about 1,000 km, respectively, southeast of Tokyo. The seventh population is in the waters around the Amami Islands which are part of the Ryukyu Islands chain (Miyazaki and Nakayama 1989). Most of these Indo-Pacific bottlenose dolphins, like in other populations throughout their range, are year-around residents (Mori and Yoshioka 2009).
- Eight species of pinnipeds (Kurile harbor seal, larga seal, ringed seal, ribbon seal, bearded seal, and northern fur seal) including one endangered one (Steller sea lion) and one extinct species (Japanese sea lion) are known from northern Japanese waters, mainly in the southern Okhotsk Sea off the northern coast on Hokkaido.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	3	0	0	0	8	3

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	Not Eligible	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	Does not qualify.	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

The Sea of Japan (Japan)

Potential Criteria:	SME did not submit criteria. (NMFS West Coast) 2A: High Density (TJ)
Species of Concern:	Finless porpoise (*Neophocaena phocaenoides*) (NMFS West Coast) Beaked whales (*Ziphiidae*) (TJ)
Proposed Boundary Consideration: *Basis: NMFS West Coast or T. Jefferson*	Total exclusion within the Sea of Japan, extending seaward of the 12 nm borders of the Korean Peninsula and Japan Bathymetry: between 550 and 2,000 meter depth contours. (TJ) ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The cetaceans, including both baleen whales and small cetaceans, found in the Sea of Japan approximately north from the southern end of the Korean Peninsula are the same as those found in the Oyashio Large Marine Ecosystem and the cetaceans to the south of the Korean Peninsula are the same as those found in the Kuroshio Large Marine Ecosystem.
- Finless porpoise are found outside the 12 nm zone of the Sea of Japan because of the shallow nature of this region. Anon. (2005) reported that "In the offshore waters (33°00′ to 37°30′N, 122°00′ to 126°00′E), two sighting surveys were conducted using the R/V Tamgu-3 in 2001 and 2004." Anon. (2005) also says that "Park reported the stock status in the Korean waters based on the abundance estimate. 2 shipboard surveys for finless porpoise were made in each offshore and inshore of the west coast of Korea. The first surveys in offshore and inshore were carried out in each 2001 and 2003 estimated an abundance of 58,650 animals in offshore and 1,571 porpoises in inshore. In 2004, it was estimated that current abundance was 21,532 animals in offshore and 5,464 porpoises in inshore."

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Total Exclusion within the Yellow Sea / East China Sea (China, North Korea, South Korea)

Potential Criteria:	SME did not submit criteria.
Species of Concern:	Gray whale (*Eschrichtius robustus*) Minke whale (*Balaenoptera acutorostrata*) Fin whale (*Balaenoptera physalus*) Humpback whale (*Megaptera novaeangliae*) Omura's whale (*Balaenoptera omurai*)
Proposed Boundary Consideration: *Basis: NMFS West Coast*	Total exclusion within the Yellow Sea and East China Sea (China) extending seaward of the 12 nm borders of the Korean Peninsula, China and Japan. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The Yellow Sea Large Marine Ecosystem is a semi-enclosed Sea bordered by three countries: China, North Korea and South Korea. The southern Yellow Sea is adjacent to the East China Sea Large Marine Ecosystem which is also a semi-enclosed body of water bordered by China, South Korean and Japan. The southern limit of the East China Sea connects to the Taiwan Strait. The warm Tsushima Current, a branch of the Kuroshio Current, is a major influence in the ECS ecosystem.
- The main baleen whales known to occur in the inshore waters are: gray whales, minke whales, fin whales and humpback whales (Zhou, 2004). In addition, Omura's whales should also be present in the coastal and offshore regions of the ECS but not the Yellow Sea (Yamada, 2009).
- A resident population of fin whales, depleted from past commercial whaling operations, is found in both the Yellow Sea and the East China Sea (Fujino, 1960). Ichihara (1957a) reported differences in the general shapes of fin whales between the western Aleutian Islands and the northern part of the East China Sea.
- Three species of beaked whales (Baird's beaked whales, Blainville's beaked whales, and gingko-toothed beaked whales) are recorded from Chinese waters (P. Wang, 1999; Zhou, 2004). No abundance estimates are available for any of these species in Chinese waters and little is known about their actual distribution except from stranded animals.

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	5	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	0	0	0	0
Status	N/A	N/A	N/A	N/A	N/A	N/A
Assessment	N/A	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Exclusion around Taiwan (China)

Potential Criteria:	SME did not submit criteria.
Species of Concern:	SME did not submit any species information.
Proposed Boundary Consideration: *Basis: NMFS West Coast*	Exclusion around Taiwan, extending 100 km (54 nm) seaward of the 12 nm border along the Pacific side (eastern coastline of Taiwan). ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Historically, the humpback whale was the most important baleen whale in Taiwanese waters, but the population was greatly depleted by commercial whalers during the first half of the 20th century.
- Additional baleen whales include minke whales, Bryde's whales and Omura's whales, but gray whales have not been confirmed from Taiwanese waters. All of the small cetaceans listed above from the Kuroshio Large Marine Ecosystem are also found in the same current off the east coast of Taiwan (J. Wang & Yang, 2007) and southward to the Philippines (Dolar, Perrin, Taylor, Kooyman, & Alava, 2006).
- Deep water is found close to shore off the eastern and southern coast of Taiwan. Population estimates are not available for these waters, but small cetaceans are abundant and form the core of the local whale-watching operations along the east coast of Taiwan. Also the same species within distant regions of the Kuroshio Large Marine Ecosystem are different populations and therefore must be assessed and managed separately (Perrin, Dolar, Amano, & Hayano, 2003).
- One of these species, the pygmy killer whale is known from six mass stranding events from the southwestern region of the island between 1995 and 2005 and an additional three near mass stranding events (Brownell et al., 2009).
- Additional MSEs in Taiwan are known for melon-headed whales, rough-toothed dolphins, and short-finned pilot whales (J. Wang and Yang, 2007).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	0	0	0	0
Status	N/A	N/A	N/A	N/A	N/A	N/A
Assessment	N/A	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Exclusion in the South China Sea (China)

Potential Criteria:	SME did not submit criteria. (NMFS West Coast) 2A: High Density (TJ)
Species of Concern:	Misc. Species (TJ)
Proposed Boundary Consideration: *Basis: NMFS West Coast or T. Jefferson*	Bathymetry: 100 km seaward of the shallow water area (NMFS West Coast) Continental shelf. (TJ) ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The main character of the South China Sea Large Marine Ecosystem (SCS) is its tropical climate. The countries bordering the SCS are: Vietnam, China, Taiwan, the Philippines, Malaysia, Thailand, Indonesia and Cambodia.
- The SCS is divided into two major areas: (1) a coastal region less them 200 m from the coast out to about 100 km and (2) a deep water region to the east of the shallow water area.
- The cetaceans found in the shallow waters are not well known and mainly consist of Indo-Pacific bottlenose dolphins, common bottlenose dolphins, Pacific humpbacked dolphins and finless porpoise.
- The offshore cetacean fauna are the same species found in the Kuroshio Large Marine Ecosystem. The main baleen whales known to occur in the offshore waters of the SCS are Bryde's whales and some humpback whales in the northeastern most SCS.
- Within the coastal region the following species have been recorded: gray whales, minke whale, fin whales and humpback whales (Zhou, 2004). In addition, Omura's whales should also be present in the coastal and offshore regions of the SCS (Yamada, 2009).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	2	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Total Exclusion in the Gulf of Tonkin (Vietnam)

Potential Criteria:	None submitted.
Species of Concern:	Indo-Pacific humpback dolphin (*Sousa chinensis*) Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) Finless porpoise (*Neophocaena phocaenoides*)
Proposed Boundary Consideration: *Basis: NMFS West Coast*	Seaward of the 12 nm borders of Vietnam and China ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- This region is the northwest arm of the South China Sea and is bounded by China to the north and east (Hainan Island) and northern Vietnam to the west. Its size is about 500 km long and 250 km wide with waters only to 70 m deep.
- The Vietnam cetacean fauna is poorly known except for coastal small cetaceans like Indo-Pacific humpback dolphin, Indo-Pacific bottlenose dolphin and finless porpoise (Smith et al., 1995).
- Other species of small cetaceans from the Kuroshio Large Marine Ecosystem are reported from Vietnam but the locations and densities are unknown. Most records from Vietnam are whales that likely stranded near the 'Whale Temples" where their bones were deposited (Smith, et al., 1995).
- The area outside the 2 nm EEZ could be an important wintering region for some of the critically endangered western gray whales and western North Pacific humpback whales (Zhou, 2004).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	2	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	0	0	0	0
Status	N/A	N/A	N/A	N/A	N/A	N/A
Assessment	No Data	No Data	No Data	No Data	No Data	No Data

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Exclusion around Wake Island (United States)

Potential Criteria:	None submitted.
Species of Concern:	None submitted.
Proposed Boundary Consideration: *Basis: NMFS West Coast*	An area extending 100 km seaward of the 12 nm EEZ. **NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Wake Island is the most northern of the Marshall Island chain. It is part of Wake Atoll, which consists of three fringing islands, Wake, Wilkes, and Peale, with a total land area of 6.5 km^2.
- The cetacean fauna in the waters around Wake is poorly known and only three species have been recorded (Brownell and Ralls, 2008). No abundance estimates are available for any of these species.
- Two Cuvier's beaked whales stranded live on Wake Island in January and February 1977 (PIRO Stranding database). Blue whales have been recorded near Wake (McDonald, et al., 2006; Stafford, Nieukirk, and Fox, 2001; Watkins et al., 2000), as have fin whales (Northrop, Cummings, and Thompson, 1967). Stafford *et al*. (2001) believed that some of the calls they reported near Wake were the Eastern Type, but it is now clear that the blue whale song type around Wake is exclusively the Western Type (M. McDonald, pers. comm.).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	0	0	1	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	0	0	0	0
Status	N/A	N/A	N/A	N/A	N/A	N/A
Assessment	No Data	No Data	No Data	No Data	No Data	No Data

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Exclusion for the North Philippine Sea (Philippines)

Potential Criteria:	2A: High Density
Species of Concern:	Misc. species
Proposed Boundary Consideration: *Basis: T. Jefferson*	Bathymetry: to the 1,000 meter depth contour. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited Dolar (1999) and Dolar et al. (2006).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	1	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	No Data	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Exclusion for the West Philippine Sea (Philippines)

Potential Criteria:	2A: High Density
Species of Concern:	Misc. species
Proposed Boundary Consideration: *Basis: T. Jefferson*	Bathymetry: to the 1,000 meter depth contour. **NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited Dolar (1999) and Dolar et al. (2006).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	1	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Exclusion for the East China Sea (China)

Potential Criteria:	2A: High Density
Species of Concern:	Baleen whales (*Mysticeti*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	The continental shelf. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited (Zhou, Leatherwood, and Jefferson, 1995) and (Zhou, 2002).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	1	0	0	0	0	0
Status	Not Eligible	N/A	N/A	N/A	N/A	N/A
Assessment	Insufficient Detail	N/A	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

IUCN Marine Region 17: Southeast Pacific

Penguin Bank (Hawaii)

Potential Criteria:	2A: High Density 2B: Breeding Area
Species of Concern:	Humpback whales (*Megaptera novaeangliae*)
Proposed Boundary Consideration: Location inferred from Mobley (2001)	157°30'58.217"W, 21°10'2.179"N to 157°30'22.367"W, 21°9'46.815"N to 157°31'0.778"W, 21°6'39.882"N to 157°30'30.049"W, 21°2'51.976"N to 157°29'28.591"W, 20°59'52.725"N to 157°27'35.919"W, 20°58'5.174"N to 157°30'58.217"W, 20°55'49.456"N to 157°42'42.418"W, 20°50'44.729"N to 157°44'45.333"W, 20°51'2.654"N to 157°46'4.716"W, 20°53'56.784"N to 157°45'33.987"W, 20°56'32.988"N to 157°43'10.586"W, 21°1'27.472"N to 157°39'27.802"W, 21°5'20.499"N to 157°30'58.217"W, 21°10'2.179" *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	January through April

Background

- The Hawaiian Islands Humpback Whale National Marine Sanctuary was created by Congress in 1992 to protect humpback whales and their habitat in Hawai'i. The sanctuary, which lies within the shallow (less than 600 feet), warm waters surrounding the main Hawaiian Islands, constitutes one of the world's most important humpback whale habitats (http://hawaiihumpbackwhale.noaa.gov/about/welcome.html)
- With the exception of a portion of Penguin Banks, the Hawaiian Islands Humpback Whale National Marine Sanctuary is located within 12 nautical miles (nm) of the islands. Penguin Bank is a shallow area of known humpback whale concentration (Mate, Gisiner, and Mobley, 1998).
- The primary period of humpback whale presence in Hawaiian waters is January through April, with peak abundance occurring earlier near the island of Hawai'i than the other islands (Gabriele, Rickards, Yin, and Frankel, 2003). Their report identified the highest whale densities near Keahole Point and just north of Kawaihae Harbor, and lower densities near the resorts along the shore south of Kawaihae (Gabriele, et al., 2003).
- The main Hawaiian Islands (MHI) are the primary winter reproductive area for the majority of North Pacific humpback whales. Identification photographs of individual whales, including 63 females sighted in at least 2 different years and with at least 1 calf, were collected from waters off the islands of Maui and Hawaii between 1977 and 1994 (Craig and Herman, 2000).
- Calves formed a significantly larger proportion of the population off Maui than off the Big Island. The overall proportion of calves to all whales identified (crude birth rate) was 0.099 off Maui and 0.061 off the Big Island (Craig and Herman, 2000).
- Aerial surveys conducted in Hawaiian waters during the winter months (Jan-Apr) of 1976-80 showed humpbacks to be most prevalent in coastal regions and shallow banks where the expanse of water less than 100-fathoms (183 m) was more extensive. Greatest densities of adult humpbacks and calf pods were found in the "four island region" (FIR) consisting of Maui, Molokai, Kahoolawe and Lanai, as well as Penguin Bank (Mobley et al., 2001).
- Mobley, Bauer and Herman (1999) confirmed the earlier preference of both adult humpbacks and calf pods for the FIR and Penguin Bank regions, but also showed a substantial increase of adult humpbacks in the Kauai/Niihau region (Mobley, et al., 2001).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	3	0	3	0	0	0
Status	Eligible	N/A	Eligible	N/A	N/A	N/A
Assessment	Adequate Justification	N/A	Adequate Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

Cross Seamount (United States)

Potential Criteria:	2B: Foraging Area
Species of Concern:	Cuvier's beaked whales (*Ziphius cavirostris*) Blainville's beaked whales (*Mesoplodon densirostris*)
Proposed Boundary Consideration:	18° 36′ N, 158° 26′ W 18° 36′ N, 158° 6′ W 18° 50′ N, 158° 26′ W 18° 50′ N, 158° 6′ W
Proposed Temporal Consideration:	Year-round, but particularly at night.

Background Provided by NMFS

- Cross Seamount is located at 18° 41′ N and 158° 18′ W in the central Pacific Ocean. The summit is approximately 5 by 7km across and ranges in depth between 450 and 350m.
- Johnston et al. (2008) conducted passive acoustic monitoring at Cross Seamount between 26 April 2005 and 19 November 2005 using a high-frequency acoustic recording package to detect odontocete echolocation sweeps. Visual examination of scrolling spectrograms from these data discovered that the most frequently detected cetacean signals were echolocation sweeps similar to those produced by Cuvier's beaked whales or Blainville's beaked whales. Almost all detections occurred during the night.
- Acoustic backscatter data indicate higher densities of organisms over the seamount and at its flanks relative to those in ambient water and show a prominent diel cycle due to vertical migratory behavior of sound scattering organisms.
- Feeding buzzes that were not frequency modulated were also occasionally associated with the echolocation signals described in the article, somewhat resembling those known to be associated with Cuvier's and Blainville's beaked whale echolocation sounds (Johnson et al. 2004).
- Highest densities over the plateau were observed during the night-time, with a prominent SSL in the upper 200m and dense patches of aggregations near the seafloor of the seamount. Trawl surveys of SSL layers in this region revealed squid and fishes, which are potential prey items for beaked whales.
- Their acoustic monitoring reveals that beaked whales foraged at Cross Seamount during most nights. The detection range (based on seafloor reflections) for these signals appears to be less than 5km, thus detected animals were at the seamount summit. Few beaked whale detections occurred during daylight hours, and several hypotheses may explain this pattern. It is possible that the whales were not present at Cross during the day or that the whales were present in the area but not echolocating. It is also possible that the whales were present, but diving past the summit of the seamount before echolocating at depth.
- It is possible that dense concentrations of prey at Cross may reduce diving demands for beaked whales, allowing them to spend greater time foraging at depth. In this case, the presence of the seamount summit may facilitate prey capture by providing a barrier against which whales concentrate prey. The author further hypothesizes that this may stem from the enhancement of local productivity by ‘seamount effects’, providing predictable patches of prey in an otherwise dilute and oligotrophic environment (Johnston, et al., 2008).
- Johnson et al. (2004) attached acoustic tags to four beaked whales (two *Mesoplodon densirostris* and two *Ziphius cavirostris*) and recorded high–frequency clicks during deep dives. The tagged whales only clicked at depths below 200 m, down to a maximum depth of 1267 m. Both species produced a large number of short, directional, ultrasonic clicks with no significant energy below 20 kHz. The tags recorded echoes from prey items; to the author’s knowledge, a first for any animal echolocating in the wild. They conclude that these echoes provide the first direct evidence on how free-ranging

toothed whales use echolocation in foraging. The strength of these echoes suggests that the source level of *Mesoplodon* clicks is in the range of 200–220 dB re 1 µPa at 1 m.

- The mesopelagic community over the summit contains two species that appear to be found in higher abundance over the summit as opposed to away and may be considered as seamount-associated species. These are a cranchiid squid, *Liocranchia reinhardti*, and a myctophid fish, *Benthosema fibulatum*. This seamount is known to impact the mesopelagic micronekton community and tuna community, but the mechanisms behind these impacts are largely unknown at this time (De Forest and Drazen, 2009).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	3	0	0	0	0
Status	N/A	Eligible	N/A	N/A	N/A	N/A
Assessment	N/A	Adequate Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at investigating and supporting the proposed boundary. Boundary surrounds the location of a core biological area of importance.

Costa Rica Dome (Costa Rica, Panama)

Potential Criteria:	2B: Foraging Area 2B: Wintering Ground
Species of Concern:	Blue whale (*Balaenoptera musculus*) Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration:	Existing boundary as defined in the 2007 Final Rule.
Proposed Seasonal Consideration:	Year-Round

Background

- The distribution of blue whales, in the eastern tropical Pacific (ETP) was analyzed from 211 sightings of 355 whales recorded during research vessel sighting surveys or by biologists aboard fishing vessels. Over 90% of the sightings were made in just two areas: along Baja California, and in the vicinity of the Costa Rica Dome. All sightings occurred in relatively cool, upwelling-modified waters. The Costa Rica Dome area was occupied year round, suggesting either a resident population, or that both northern and southern hemisphere whales visit with temporal overlap (Reilly and Thayer, 1990).
- Research conducted in the 1990s reported that some humpback whales from the North Pacific were also using Costa Rican waters as a wintering ground (Acevedo-Gutiérrez and Smultea, 1995).
- With blue whales, the greatest unknown is whether their year-round residency on the Costa Rica Dome is indicative of a distinct, non-migratory population segment or whether some individuals may choose not to migrate every year (Calambokidis, et al., 1990).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	1	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	3	0	0	0	0
Status	N/A	Eligible	N/A	N/A	N/A	N/A
Assessment	N/A	Adequate Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

IUCN Marine Region 18: Australia – New Zealand

Great Barrier Reef Between 16°E and 21°S (Australia)

Potential Criterion:	2B: Breeding Ground
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) Dwarf Minke whale (*Balaenoptera acutorostrata*)
Proposed Boundary Consideration: Location inferred from Arnold (1997)	145°38'46.988"E, 16°1'49.75"S to 146°20'56.18"E, 15°52'12.917"S to 146°59'23.514"E, 17°28'21.251"S to 151°39'40.427"E, 20°16'13.65"S to 150°30'53.849"E, 20°58'22.843"S to 146°49'46.681"E, 18°51'10.893"S to 145°38'46.988"E, 16°1'49.75"S
Proposed Seasonal Consideration:	May through September

Background

- Of particular concern in the Marine Park is a population of dwarf minke whales occurring off northern Queensland, most often seen in the Ribbon Reefs area in June and July although present in the Park from about May to October (GBRMP, 2000).
- An IWC compilation of 181 sightings from the central and northern Great Barrier Reef indicated that dwarf minke whales were regularly seen between Cairns (16°55' S) and Yonge Reef (14° 36' S). Sightings occurred from May to September, with 79.5% of sightings in June and July. Observations suggest, however, that groups of animals may occur in open water on the continental shelf, inshore of the reefs where most whales have been reported. Records of stranded animals 3 m or less in length indicate calving can occur at about 24E-38E S in Australia. There were four reports of cow-calf pairs on the northern Great Barrier Reef, between 15°-16°S, but more information is needed to assess the extent to which the area is a calving/nursery ground (Arnold, 1997).
- Humpback whales which migrate along the east Australian coast comprise part of the Area V (130° E - 170° W) stock. Sheltered water within the Great Barrier Reef between latitudes 16°-21° S appear to be an important breeding ground for the east Australian humpback whale stock (Paterson and Paterson, 1984).
- The humpback whales present in the marine park generally spend the summer feeding in the nutrient-rich waters of Antarctica, migrate northwards in the autumn, and winter in warm-water breeding areas, including the waters off the coast of Queensland. Humpbacks are usually present in the Marine Park from June to October. Of particular concern in the Marine Park are possible adverse effects on pregnant females and cows with young calves. Lactating females typically migrate north before pregnant females, and cows with newborn calves tend to be last to leave the breeding areas to return south to the feeding grounds. Thus, cows who are pregnant or who have young (dependent) calves are present in the Marine Park throughout the season (GBRMP, 2000).

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	0	3	0	0	0
Status	N/A	N/A	Eligible	N/A	N/A	N/A
Assessment	N/A	N/A	Adequate Justification	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Bonney Upwelling **(Australia)**

Potential Criterion:	2B: Foraging Area
Species of Concern:	Blue whale (*Balaenoptera musculus*) Pygmy blue whale (*B. m. brevicauda*) New Zealand fur seal (*Arctocephalus forsteri*) Southern right whale (*Eubalaena australis*) Australian sea lion (*Neophoca cinera*)
Proposed Boundary Consideration: Location inferred from Gill (2002)	139°31'17.703"E, 37°12'20.036"S to 139°42'42.508"E, 37°37'33.815"S to 140°22'57.345"E, 38°10'36.144"S to 141°33'50.342"E, 38°44'50.558"S to 141°11'0.733"E, 39°7'4.125"S to 139°10'52.263"E, 37°28'33.179"S
Proposed Seasonal Consideration:	November through May

Background

- The Bonney Upwelling (formerly the Blue Whale aggregation) is characterized by classical upwelling plumes regularly observed along the Bonney Coast (Robe, South Australia to Portland, Victoria).
- To assess how seasonal changes in ocean productivity influenced foraging behavior, one study fitted18 lactating New Zealand fur seals with satellite transmitters and time-depth recorders (TDRs). Using temperature and depth data from TDRs, they used the presence of thermoclines as a surrogate measure of upwelling activity in continental- shelf waters. The study concluded that lactating New Zealand fur seals shift their foraging location from continental-shelf to oceanic waters in response to a seasonal decline in productivity over the continental shelf, attributed to the cessation of the Bonney upwelling (Baylis, Page, and Goldsworthy, 2008).
- A localized aggregation of blue whales, which may be pygmy blue whales, occurs in southern Australian coastal waters (between 139°45' E-143°E) during summer and autumn (December-May), where they feed on coastal krill (*Nyctiphanes australis*), a species which often forms surface swarms. While the abundance of blue whales using this area is unknown, up to 32 blue whales have been sighted in individual aerial surveys. Krill appear to aggregate in response to enhanced productivity resulting from the summer-autumn wind-forced Bonney Coast upwelling along the continental shelf. During the upwelling's quiescent (winter-spring) period, blue whales appear to be absent from the region. Krill surface swarms have been associated with 48% of 261 blue whale sightings since 1998, with direct evidence of feeding observed in 36% of all sightings. Mean blue whale group size was 1.55 (SD = 0.839), with all size classes represented including claves. This seasonally predictable upwelling system is evidently a regular feeding ground for blue whales (Gill, 2002).
- http://bluewhalestudy.com/home.html

Number of Supporting Documents

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	1	0	0	0

NMFS' Classification Scores for Supporting Documents

	High Density	Foraging Area	Breeding / Calving Area	Migration Route	Critical Habitat	Small Distinct Population
Rank	0	3	0	0	0	0
Status	N/A	Eligible	N/A	N/A	N/A	N/A
Assessment	N/A	Adequate Justification	N/A	N/A	N/A	N/A

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Works Cited

Abend, A. (1993). *Distribution and diet of long-finned pilot whales as determined from stable carbon and nitrogen ratio isotope tracers.* University of Massachusetts, Amherst, MA.

Abend, A., & Smith, T. (1999). Review of Distribution of the Long-finned Pilot Whale (Globicephala melas) in the North Atlantic and Mediterranean.

Acevedo-Gutiérrez, A., & Smultea, M. (1995). First records of humpback whales including calves at Golfo Dulce and Isla del Coco, Costa Rica, suggesting geographical overlap of Northern and Southern hemisphere populations. *Marine Mammal Science., 11*(4), 554-560.

Anon. (2005). *Report of the Workshop on Finless Porpoises in theWestern North Pacific. (Available from IWC, The Red House, 135 Station Road, Impington, Cambridge C24 9NP, UK.).*

Anon. (2010). *Progress report on the Med09 cruise. ACCOBAMS, 6th Meeting of the Scientific Committee, Casablanca, 11-13 January 2010. Document SC6-Inf 06. 21 p.*

Arcangeli, A., Muzi, E., Tepsich, P., Carcassi, S., Castelli, A., Crosti, R., et al. (2009). *Large-scale cetacean monitoring from passenger ferries in Italy: networking summer 2008 surveys. Proceedings of the 23rd Conference of the European Cetacean Society, Istanbul. 6 p.*

Arnold, P. (1997). *Occurrence of dwarf minke whales (Balaenoptera acutorostrata) on the northern Great Barrier Reef, Australia*.

Azzellino, A., Gaspari, S., Airoldi, S., & Nani, B. (2008). Habitat use and preferences of cetaceans along the continental slope and the adjacent pelagic waters in the western Ligurian Sea. *Deep-Sea Research Part I: Oceanographic Research Papers, 55*(3), 296-323.

Baraff, L., Clapham, P., Mattila, D., & Bowman, R. (1991). Feeding behavior of a humpback whale in low-latitude waters. *Marine Mammal Science, 7*(2), 197-202.

Barlow, J., & Forney, K. (2007). Abundance and population density of cetaceans in the California Current ecosystem. *FISHERY BULLETIN-NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, 105*(4), 509.

Baumgartner, M., Cole, T., Clapham, P., & Mate, B. (2003). North Atlantic right whale habitat in the lower Bay of Fundy and on the SW Scotian Shelf during 1999-2001. *Marine Ecology Progress Series, 264*, 137-154.

Baylis, A., Page, B., & Goldsworthy, S. (2008). Effect of seasonal changes in upwelling activity on the foraging locations of a wide-ranging central-place forager, the New Zealand fur seal. *Canadian Journal of Zoology, 86*(8), 774-789.

Bearzi, G., Costa, M., Politi, E., Agazzi, S., Pierantonio, N., Tonini, D., et al. (2009). Cetacean records and encounter rates in the Northern Adriatic Sea during the years 1988-2007. *Annales, 19*(2), 145-150.

Beasley, I., Davidson, P., Somany, P., & Ath, L. (2002). *Abundance, distribution and conservation management of marine mammals in Cambodia's coastal waters. Unpublished report.*

Beier, E., & Ripa, P. (1999). Seasonal gyres in the northern Gulf of California. *Journal of Physical Oceanography, 29*(2), 305-311.

Ben Naceur, L., Gannier, A., Bradai, M. N., Drouot, V., Bourreau, S., Laran, S., et al. (2004). Recensement du grand dauphin Tursiops truncatus dans les eaux tunisiennes. *Bull. Inst. Natn. Scien. Tech. Mer de Salammbô, 31*.

Best, P. (2001). Distribution and population separation of Bryde's whale Balaenoptera edeni off southern Africa. *Marine Ecology Progress Series*, *220*, 277-289.

Best, P. (2007). *Whales and dolphins of the southern African subregion*: Cambridge University Press.

Best, P., Findlay, K., Sekiguchi, K., Peddemors, V., Rakotonirina, B., Rossouw, A., et al. (1998). Winter distribution and possible migration routes of humpback whales Megaptera novaeangliae in the southwest Indian Ocean. *MEPS*, *162*, 287-299.

Best, P., Glass, J., Ryan, P., & Dalebout, M. (2009). Cetacean records from Tristan da Cunha, South Atlantic. *Journal of the Marine Biological Association of the UK*, *89*(Special Issue 05), 1023-1032.

Best, P., Rademeyer, R., Burton, C., Ljungblad, D., Sekiguchi, K., Shimada, H., et al. (2003). The abundance of blue whales on the Madagascar Plateau, December 1996. *Journal of Cetacean Research and Management*, *5*(3), 253-260.

Bordino, P., Albareda, D., & Fidalgo, G. (2004). *Abundance estimation of Franciscana dolphin Pontoporia blainvillei from boat surveys in Buenos Aires, Argentina. International Whaling Commission, Cambridge, UK, Scientific Committee Document SC/56/SM13*.

Bordino, P., Kraus, S., Albareda, D., Fazio, A., Palmerio, A., Mendez, M., et al. (2002). Reducing incidental mortality of Franciscana dolphin *Pontoporia blainvillei* with acoustic warning devices attached to fishing nets. *Marine Mammal Science*, *18*(4), 833-842.

Bordino, P., & Wells, R. (2005). *Radiotracking of Franciscana Dolphins (Pontoporia Blainvillei) in Bahia Samborombon, Buenos Aires, Argentina*. Paper presented at the 16th Biennial Conference on the Biology of Marine Mammals, San Diego, California (USA), 12-16 Dec 2005.

Bordino, P., Wells, R., & Stamper, M. (2008). *Satellite tracking of Franciscana Dolphins Pontoporia blainvillei in Argentina: preliminary information on ranging, diving and social patterns. Paper SC/53/IA32 presented to the IWC Scientific Committee, (unpublished)*.

Branch, T., Stafford, K., Palacios, D., Allison, C., Bannister, J., Burton, C., et al. (2007). Past and present distribution, densities and movements of blue whales Balaenoptera musculus in the Southern Hemisphere and northern Indian Ocean. *Mammal Review*, *37*(2), 116-175.

Brownell, R., & Ralls, K. (2008). Cetacean records from U. S. Commonwealth and Territories in the Pacific Ocean. PSRG-2008-15.

Brownell, R., Yamada, T., Mead, J., & Allen, B. (2006). *Mass strandings of melon-headed whales, Peponocephala electra: a worldwide review. SC/58/SM 8, 12 pp. (Available from IWC, The Red House, 135 Station Road, Impington, Cambridge C24 9NP, UK.)*.

Brownell, R., Yamada, T., Mead, J., & Van Helden, A. (2004). Mass strandings of Cuvier's beaked whales in Japan: US Naval acoustic link. *Unpublished paper SC/56/ E, 37*.

Brownell, R., Yao, C., Lee, C., Wang, M., Yang, W., & Chou, L. (2009). Worldwide review of pygmy killer whales, Feresa attenuata, Mass Strandings Reveals Taiwan Hot Spot. *SC/61/SM1, 20 pp. (Available from IWC, The Red House, 135 Station Road, Impington, Cambridge C24 9NP, UK.)*.

Buckland, S., Anderson, D., Burnham, K., & Laake, J. (1993). *Distance sampling: Estimating abundance of biological populations*: Chapman & Hall London.

Buckland, S., Cattanach, K., & Miyashita, T. (1992). *Minke whale abundance in the northwest Pacific and the Okhotsk Sea, estimated from 1989 and 1990 sighting surveys*.

Burtenshaw, J. C., Oleson, E. M., Hildebrand, J. A., McDonald, M. A., Andrew, R. K., Howe, B. M., et al. (2004). Acoustic and satellite remote sensing of blue whale seasonality and habitat in the Northeast Pacific. *Deep Sea Research (Part II, Topical Studies in Oceanography), 51*(10-11), 967-986.

Böhm, E., Hopkins, T. S., Pietrafesa, L. J., & Churchill, J. H. Continental slope sea level and flow variability induced by lateral movements of the Gulf Stream in the Middle Atlantic Bight. *Progress In Oceanography, 70*(2-4), 196-212.

Böhm, E., Hopkins, T. S., Pietrafesa, L. J., & Churchill, J. H. (2006). Continental slope sea level and flow variability induced by lateral movements of the Gulf Stream in the Middle Atlantic Bight. *Progress In Oceanography, 70*(2-4), 196-212.

Calambokidis, J., Steiger, G., Cubbage, J., Balcomb, K., Ewald, C., Kruse, S., et al. (1990). *Sightings and movements of blue whales off central California 1986-88 from photo-identification of individuals*.

Calambokidis, J., Steiger, G., Ellifrit, D., Troutman, B., & Bowlby, C. (2004). Distribution and abundance of humpback whales(Megaptera novaeangliae) and other marine mammals off the northern Washington coast. *Fishery Bulletin, 102*(4), 563-580.

Campagna, C., Fedak, M., & McConnell, B. (1999). Post-breeding distribution and diving behavior of adult male southern elephant seals from Patagonia. *Journal of Mammalogy, 80*(4), 1341-1352.

Campagna, C., Le Boeuf, B., Blackwell, S., Crocker, D., & Quintana, F. (1995). Diving behaviour and foraging location of female southern elephant seals from Patagonia. *Journal of Zoology, 236*(1), 55-71.

Campagna, C., & Lewis, M. (1992). Growth and distribution of a southern elephant seal colony. *Marine Mammal Science, 8*(4), 387-396.

Campagna, C., Piola, A., Marin, M., Lewis, M., Zajaczkovski, U., & Fernández, T. (2007). Deep divers in shallow seas: Southern elephant seals on the Patagonian shelf. *Deep Sea Research Part I: Oceanographic Research Papers, 54*(10), 1792-1814.

Campagna, C., Piola, A., Rosa Marin, M., Lewis, M., & Fernández, T. (2006). Southern elephant seal trajectories, fronts and eddies in the Brazil/Malvinas Confluence. *Deep-Sea Research Part I, 53*(12), 1907-1924.

Campagna, C., Quintana, F., Le Boeuf, B., Blackwell, S., & Crocker, D. (1998). Diving behaviour and foraging ecology of female southern elephant seals from Patagonia. *Aquatic Mammals, 24*, 1-12.

Campagna, C., Rivas, A., & Marin, M. (2000). Temperature and depth profiles recorded during dives of elephant seals reflect distinct ocean environments. *Journal of Marine Systems, 24*(3-4), 299-312.

Carretta, J. V., Forney, K. A., Lowry, M. S., Barlow, J., Baker, J., Hanson, B., et al. (2008). *U.S. Pacific Marine Mammal Stock Assessments: 2008* (Report No. NOAA-TM-NMFS-SWFSC-434).

Carrillo, L., & Palacios-Hernandez, E. (2002). Seasonal evolution of the geostrophic circulation in the northern Gulf of California. *Estuarine, Coastal and Shelf Science, 54*(2), 157-173.

Cañadas, A., & Hammond, P. (2008). Abundance and habitat preferences of the short-beaked common dolphin Delphinus delphis in the southwestern Mediterranean: implications for conservation. *Endangered Species Research, 4*(3), 309.

Cañadas, A., Sagarminaga, R., De Stephanis, R., Urquiola, E., & Hammond, P. (2005). Habitat preference modelling as a conservation tool: proposals for marine protected areas for cetaceans in southern Spanish waters. *Aquatic Conservation: Marine and Freshwater Ecosystems, 15*(5), 495-521.

Cerchio, S., Andrianarivelo, N., Razafindrakoto, Y., Mendez, M., & Rosenbaum, H. (2009). *Coastal dolphin hunting in the southwest of Madagascar: status of populations, human impacts and conservation actions. In: Paper SC/61/SM15 presented to the IWC Scientific Committee, May 2009. 9pp.*

Cerchio, S., Ersts, P., Pomilla, C., Loo, J., Razafindrakoto, Y., Leslie, M., et al. (2009). *Updated estimates of abundance for humpback whale breeding stock C3 off Madagascar, 2000-2006. In: Paper SC/61/SH7 presented to the IWC Scientific Committee, May 2009 (unpublished). 23pp.*

Churchill, J., Levine, E., Connors, D., & Cornillon, P. (1993). Mixing of shelf, slope and Gulf Stream water over the continental slope of the Middle Atlantic Bight. *Deep Sea Research Part I: Oceanographic Research Papers, 40*(5), 1063-1085.

CIRVA. (1997). *Comite Internacional Para la Recuperacion de la Vaquita/International Committee for the Recovery of the Vaquita. Scientific Reports of: First Meeting, 25-26 January 1997.*

CIRVA. (1999). *Comite Internacional Para la Recuperacion de la Vaquita/International Committee for the Recovery of the Vaquita. Scientific Reports of the Second Meeting,7-11 February 1999.*

CIRVA. (2004). *Comite Internacional Para la Recuperacion de la Vaquita/International Committee for the Recovery of the Vaquita. Scientific Reports of the Third Meeting, 18-24 January 2004.*

Clapham, P., & Mattila, D. (1990). Humpback whale songs as indicators of migration routes. *Marine Mammal Science, 6*(2), 155-160.

Collins, T., Cerchio, S., Pomilla, C., Carvalho, I., Ngouessono, S., & Rosenbaum, H. (2008). Revised estimates of abundance for humpback whale breeding stock B1: Gabon. In: Paper SC/60/SH28 presented to the IWC Scientific Committee, May 2008 (unpublished). 17pp.

Collins, T., Ngouessono, S., & Rosenbaum, H. (2004). *A note on recent surveys for Atlantic humpback dolphins, Sousa teuszii (Kukenthal, 1892) in the coastal waters of Gabon*.

Craig, A., & Herman, L. (2000). Habitat preferences of female humpback whales Megaptera novaeangliae in the Hawaiian Islands are associated with reproductive status. *Marine Ecology Progress Series, 193*, 209-216.

Crespo, E., Pedraza, S., Grandi, M., Dans, S., & Garaffo, G. (2004). *Abundance of franciscana dolphins, Pontoporia blainvillei, in the argentine coast, from aerial surveys. SC/56/SM9 Working paper submitted to the meeting of the International Whaling Commission, Sorrento, Italy, 29/6 to 10/7/04.*

Crespo, E., Pedraza, S., Grandi, M., Dans, S., & Garaffo, G. (2010). Abundance and distribution of endangered Franciscana dolphins in Argentine waters and conservation implications. *Marine Mammal Science, 26*(1), 17-35.

Croll, D. A., Marinovic, B., Benson, S., Chavez, F. P., Black, N., Ternullo, R., et al. (2005). From wind to whales: trophic links in a coastal upwelling system. *Marine Ecology Progress Series, 289*, 117-130.

D' Amico, A., Bergamasco, A., Zanasca, P., Carniel, S., Nacini, E., Portunato, N., et al. (2003). Qualitative correlation of marine mammals with physical and biological parameters in the Ligurian Sea. *IEEE Journal of Oceanic Engineering, 28*(1), 29-43.

Danilewicz, D., Tavares, M., Moreno, I., Ott, P., & Trigo, C. (2009). Evidence of feeding by the humpback whale (Megaptera novaeangliae) in mid-latitude waters of the western South Atlantic. *Marine Biodiversity Records, 2*, e88.

De Forest, L., & Drazen, J. (2009). The influence of a Hawaiian seamount on mesopelagic micronekton. *Deep Sea Research Part I: Oceanographic Research Papers, 56*(2), 232-250.

DFO. (2007). *Recovery Potential Assessment Of Northern Bottlenose Whale, Scotian Shelf Population. Science Advisory Report 2007/011*.

Dolar, M. (1999). *Abundance, distribution and feeding ecology of small cetaceans in the eastern Sulu Sea and Tañon Strait, Philippines.* University of California, San Diego.

Dolar, M., Perrin, W., Taylor, B., Kooyman, G., & Alava, M. (2006). Abundance and distributional ecology of cetaceans in the central Philippines. *Journal of Cetacean Research and Management, 8*(1), 93.

DON. (2007a). *Navy OPAREA density estimates (NODE) for the Northeast OPAREAS: Boston, Narragansett Bay, and Atlantic. Naval Facilities Engineering Command, Atlantic; Norfolk, Virginia. Contract N62470-02-D-9997, Task Order 0045. Prepared by Geo-Marine, Inc., Plano, Texas*.

DON. (2007b). *Navy OPAREA Density Estimates (NODE) for the Southeast OPAREAS: VACAPES, CHPT, JAX/CHASN, and Southeastern Florida & AUTEC-Andros, Prepared for U.S. Fleet Forces Command, Norfolk, VA.*

Durbin, E., Campbell, R., Casas, M., Ohman, M., Niehoff, B., Runge, J., et al. (2003). Interannual variation in phytoplankton blooms and zooplankton productivity and abundance in the Gulf of Maine during winter. *Marine Ecology Progress Series, 254*, 81-100.

Ersts, P., & Rosenbaum, H. (2003). Habitat preference reflects social organization of humpback whales (Megaptera novaeangliae) on a wintering ground. *Journal of Zoology, 260*(04), 337-345.

Falabella, V., Campagna, C., & Croxall, J. (2009). *Atlas del Mar Patagónico Especies y espacios, Wildlife Conservation Society Argentina. WCS*: Cambridge: BirdLife International.

Ferguson, M., & Barlow, J. (2001). *Spatial distribution and density of cetaceans in the eastern tropical Pacific Ocean based on summer/fall research vessel surveys in 1986-96. Admin. Rept*: LJ-01-04 available from the Southwest Fisheries Science Center, 8604 La Jolla Shores Dr., La Jolla, CA 92037. 61pp.+ Addendum.

Ferguson, M., & Barlow, J. (2003). *Addendum: Spatial distribution and density of cetaceans in the eastern tropical Pacific Ocean based on summer/fall research vessel surveys in 1986-96*: Administrative Report LJ-01-04 (addendum), Southwest Fisheries Science Center, National Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037.

Ferguson, M., Barlow, J., Fiedler, P., Reilly, S., & Gerrodette, T. (2006). Spatial models of delphinid (family Delphinidae) encounter rate and group size in the eastern tropical Pacific Ocean. *Ecological Modelling, 193*(3-4), 645-662.

Ferguson, M., Barlow, J., Reilly, S., & Gerrodette, T. (2006). Predicting Cuvier's (Ziphius cavirostris) and Mesoplodon beaked whale population density from habitat characteristics in the eastern tropical Pacific Ocean. *Journal of Cetacean Research and Management, 7*(3), 287.

Fiedler, P., Reilly, S., Hewitt, R., Demer, D., Philbrick, V., Smith, S., et al. (1998). Blue whale habitat and prey in the California Channel Islands. *Deep-Sea Research Part II, 45*(8-9), 1781-1801.

Findlay, K. (2001). A review of humpback whale catches by modern whaling operations in the Southern Hemisphere. *MEMOIRS-QUEENSLAND MUSEUM, 47*(2), 411-420.

Forcada, J., Aguilar, A., Hammond, P., Pastor, X., & Aguilar, R. (2006). Distribution and numbers of striped dolphins in the western Mediterranean Sea after the 1990 epizootic outbreak. *Marine Mammal Science, 10*(2), 137-150.

Forcada, J., Gazo, M., Aguilar, A., Gonzalvo, J., & Fernández-Contreras, M. (2004). Bottlenose dolphin abundance in the NW Mediterranean: addressing heterogeneity in distribution. *Marine Ecology Progress Series*, *275*, 275-287.

Forcada, J., Notarbartolo di Sciara, G., & Fabbri, F. (1995). Abundance of fin whales and striped dolphins summering in the Corso-Ligurian Basin. *Mammalia, 59*(1), 127-140.

Forney, K. (2007). Preliminary estimates of cetacean abundance along the US west coast and within four National Marine Sanctuaries during 2005. US Department of Commerce. *NOAA Technical Memorandum NMFS-SWFSC-406. 27p*.

Frantzis, A., Swift, R., Gillespie, D., Menhennett, C., Gordon, J., & Gialinakis, S. (1999). Sperm whale presence off south-west Crete, Greece, eastern Mediterranean. *Eur Res Cet*, *13*, 214-217.

Fujino, K. (1960). Immunogenetic and marking approaches to identifying sub-populations of the North Pacific whales. *Sci. Rep. Whales Res. Inst., Tokyo, 15*, 84-142.

Gabriele, C., Rickards, S., Yin, S., & Frankel, A. (2003). *Trends in Relative Distribution, Abundance and Population Composition of Humpback Whales, Megaptera novaeangliae, in Kawaihae Bay, Hawai'i 1988-2003. Final Report August 2003 for the Department of Land and Natural Resources, State of Hawai'I and the Hawaiian Islands Humpback Whale National Marine Sanctuary, National Marine Sanctuary Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.*

Gannon, D., Craddock, J., & Read, A. (1998). Autumn food habits of harbor porpoises, Phocoena phocoena, in the Gulf of Maine. *Fishery Bulletin, 96*(3), 428-437.

Garrison, L., Martinez, A., & Maze-Foley, K. ((in review)). Habitat and abundance of marine mammals in continental slope waters of the Southeastern U.S. Atlantic.

Garrison, L., Swartz, S., Martinez, A., Burks, C., Stamates, J., & Fisheries, N. (2003). A marine mammal assessment survey of the southeast US continental shelf: February-April 2002. *NOAA Technical Memorandum NMFS-SEFSC-492. US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center*.

GBRMP. (2000). Whale and dolphin conservation in the Great Barrier Reef Marine Park: policy document. *B. a. WHG Species Conservation Team & Conservation, ed. Great Barrier Reef Marine Park Authority*, 69.

Genov, T., Kotnjek, P., Lesjak, J., Hace, A., & Fortuna, C. (2008). *Bottlenose dolphins (Tursiops truncatus) in Slovenian and adjacent waters (northern Adriatic Sea)*.

Gill, P. (2002). A blue whale (Balaenoptera musculus) feeding ground in a southern Australian coastal upwelling zone. *J. Cetacean Res. Manage, 4*(2), 179-184.

Gilles, A., Herr, H., Lehnert, K., Scheidat, M., & Siebert, U. (2008). Harbour porpoises abundance estimates and seasonal distribution patterns. *Marine mammals and seabirds in front of offshore wind energy. Wiesbaden: BG Teuber Verlag/GWV Fachverlage GmbH*, 19-36.

GOJ. (2007). Government of Japan website for Dall's porpoise abundance estimates., from http://kokushi.job.affrc.go.jp/H20/H20_46.pdf

Gutiérrez, O., Marinone, S., & Parés-Sierra, A. (2004). Lagrangian surface circulation in the Gulf of California from a 3D numerical model. *Deep Sea Research Part II: Topical Studies in Oceanography, 51*(6-9), 659-672.

Gómez de Segura, A., Crespo, E., Pedraza, S., Hammond, P., & Raga, J. (2006). Abundance of small cetaceans in waters of the central Spanish Mediterranean. *Marine Biology, 150*(1), 149-160.

Haley, N., & Read, A. (1993). Summary of the workshop on harbor porpoise mortalities and human interaction. *NOAA Tech. Mem. NMFS-F/NER, 5*.

Hamazaki, T. (2002). Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic ocean(from Cape Hatteras, North Carolina, U. S. A. to Nova Scotia, Canada). *Marine Mammal Science, 18*(4), 920-939.

Hansen, L., Mullin, K., Jefferson, T., & Scott, G. (1996). Visual surveys aboard ships and aircraft. *Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report, 2*, 96-0027.

Hare, J., Churchill, J., Cowen, R., Berger, T., Cornillon, P., Dragos, P., et al. (2002). Routes and rates of larval fish transport from the southeast to the northeast United States continental shelf. *Limnology and Oceanography*, 1774-1789.

Hayano, A. e. a. (2004). *Life history and group composition of melon-headed whales based on mass strandings on the Japanese coast. In: the Seventeenth Biennial Conference on the Biology of Marine Mammals, Abstract, Society for Marine Mammalogy, Cape Town, South Africa.* Paper presented at the Seventeenth Biennial Conference on the Biology of Marine Mammals.

Hayano, A. e. a. (2007). *Life history and group composition of melon-headed whales based on mass strandings on the Japanese coast. In: the Seventeenth Biennial Conference on the Biology of Marine Mammals, Abstract, Society for Marine Mammalogy, Cape Town, South Africa.* Paper presented at the Seventeenth Biennial Conference on the Biology of Marine Mammals.

Heimlich-Boran, J. R. (1993). *Social organization of the short-finned pilot whale, Globicephala macrorhynchus, with reference to the comparative social ecology of delphinids.* Cambridge University.

Holden, C. (2007). WHALE SENSING. *Science, 315*(5816), 1199d.

Hooker, S., Iverson, S., Ostrom, P., & Smith, S. (2001). Diet of northern bottlenose whales inferred from fatty-acid and stable-isotope analyses of biopsy samples. *Canadian Journal of Zoology, 79*(8), 1442-1454.

Hooker, S., Whitehead, H., & Gowans, S. (2002). Ecosystem consideration in conservation planning: energy demand of foraging bottlenose whales (Hyperoodon ampullatus) in a marine protected area. *Biological Conservation, 104*(1), 51-58.

Ichihara, T. (1957a). An application of linear discriminant function to external measurements of fin whale. *Scient. Rep. Whales Res. Inst., Tokyo, 12*, 127—189.

Ichihara, T. (1957b). An application of linear discriminant function to external measurements of fin whale. *Scient. Rep. Whales Res. Inst., Tokyo, 12*, 127—189.

IMO. (2007). *International Maritime Organization, Routing measures other than Traffic Separation Schemes. Ref. T2-OSS/2.7, SN.1/Circ.263,*.

Jaramillo-Legorreta, A., & Rojas-Bracho, L. (2008). *Passive acoustic assesment of vaquita. Paper SC/60/SM3 presented to the IWC Scientific Committee, 2008 (unpublished). 8pp.*

Jaramillo-Legorreta, A., Rojas-Bracho, L., Brownell, R., Read, A., Reeves, R., Ralls, K., et al. (2007). Saving the vaquita: immediate action, not more data. *Conservation Biology, 21*(6), 1653-1655.

Jaramillo-Legorreta, A., Rojas-Bracho, L., & Gerrodette, T. (1999). A new abundance estimate for vaquitas: first step for recovery. *Marine Mammal Science, 15*(4), 957-973.

Jefferson, T., Hung, S., Law, L., Torey, M., & Tregenza, N. (2002). Distribution and abundance of finless porpoises in Hong Kong and adjacent waters of China. *Raffles Bulletin of Zoology, 50*, 43-56.

Johnson, M., Madsen, P., Zimmer, W., De Soto, N., & Tyack, P. (2004). Beaked whales echolocate on prey. *Proceedings of the Royal Society of London. Series B: Biological Sciences, 271*(Suppl 6), S383.

Johnson, S., Richardson, W., Yazvenko, S., Blokhin, S., Gailey, G., Jenkerson, M., et al. (2007). A western gray whale mitigation and monitoring program for a 3-D seismic survey, Sakhalin Island, Russia. *Environmental Monitoring and Assessment, 134*(1), 1-19.

Johnston, D., McDonald, M., Polovina, J., Domokos, R., Wiggins, S., & Hildebrand, J. (2008). Temporal patterns in the acoustic signals of beaked whales at Cross Seamount. *Biology Letters, 4*(2), 208.

Johnston, D., Westgate, A., & Read, A. (2005). Effects of fine-scale oceanographic features on the distribution and movements of harbour porpoises *Phocoena phocoena* in the Bay of Fundy. *Marine Ecology Progress Series, 295*, 279-293.

Kahn, B. (2001). Komodo National Park cetacean surveys: A rapid ecological assessment of cetacean diversity, abundance, and distribution. Interim report - October 2001.

Kahn, B., Wawandono, N., & Subijanto, J. (2001). Positive identification of the rare pygmy Bryde's whale (*Balaenoptera edeni*) with the assistance of genetic profiling. Unpublished Unpublished contract report.

Kasuya, T., & Miyashita, T. (1988). Distribution of sperm whale stocks in the North Pacific. *Scientific Reports of the Whales Research Institute (Tokyo), 39*, 31-75.

Kasuya, T., & Miyashita, T. (1997). Distribution of Baird's beaked whales off Japan. *Report of the International Whaling Commission, 47*, 963–968.

Kasuya, T., Miyashita, T., & Kasamatsu, F. (1988). Segregation of two forms of short-finned pilot whales off the Pacific coast of Japan. *Sci. Rep. Whales Res. Inst, 39*, 77-90.

Kasuya, T., & Tai, S. (1993). Life history of short-finned pilot whale stocks off Japan and a description of the fishery. *Report of the International Whaling Commission*, 439-473.

Kato, H. (1992). *Body length, reproduction and stock separation of minke whales off northern Japan*.

Keller, C., Ward-Geiger, L., Brooks, W., Slay, C., Taylor, C., & Zoodsma, B. (2006). North Atlantic right whale distribution in relation to sea-surface temperature in the southeastern United States calving grounds. *Marine Mammal Science, 22*(2), 426.

Kenney, R., Winn, H., & Macaulay, M. (1995). Cetaceans in the Great South Channel, 1979-1989: right whale (Eubalaena glacialis). *Continental Shelf Research, 15*(4-5), 385-414.

Kenney, R., & Wishner, K. (1995). The South Channel Ocean Productivity EXperiment. *Continental Shelf Research, 15*(4-5), 373-384.

Kiszka, J., Berggren, P., Rosenbaum, H., Cerchio, S., Rowat, D., Drouot-Dulau, V., et al. (2009). *Cetaceans in the southwest Indian Ocean: a review of diversity, distribution and conservation issues. Paper SC/61/O18 presented to the IWC Scientific Committee, May 2009 (unpublished). 12pp.*

Koopman, H. (1998). Topographical distribution of the blubber of harbor porpoises (Phocoena phocoena). *Journal of Mammalogy, 79*(1), 260-270.

Kraus, S., Hamilton, P., Kenney, R., Knowlton, A., & Slay, C. (2001). Reproductive parameters of the North Atlantic right whale. *Journal of Cetacean Research and Management, 2*, 231-236.

Lasta, C. (1995). La Bahía Samborombón: zona de desove y cría de peces.

Lasta, C., & Acha, E. (1996). Cabo San Antonio: su importancia en el patrón reproductivo de peces marinos.[Cape San Antonio: its importance for reproductive pattern of marine fishes]. *Frente Marítimo, 16*, 39-45.

Leatherwood, S., Caldwell, D., Winn, H., Schevill, W., & Caldwell, M. (1976). Whales, dolphins, and porpoises of the western North Atlantic: a guide to their identification. from http://aquacomm.fcla.edu/1417/2/NOAA_Tech_Rpt_NMFS_CIRC-396.pdf

Lewis, T. (2010). *Preliminary abundance estimate of sperm whales in the SW Mediterranean from an acoustic line-transect survey. ACCOBAMS, 6th Meeting of the Scientific Committee, Casablanca, 11-13 January 2010. Document SC6-Inf 13. 8 p.*: ACCOBAMS.

Link, J., Overholtz, W., O'Reilly, J., Green, J., Dow, D., Palka, D., et al. (2008). The Northeast U.S. continental shelf Energy Modeling and Analysis exercise (EMAX): Ecological network model development and basic ecosystem metrics. *Journal of Marine Systems, 74*(1-2), 453-474.

Lázaro, M., Lessa, E., & Hamilton, H. (2004). Geographic genetic structure in the franciscana dolphin (Pontoporia blainvillei). *Marine Mammal Science, 20*(2), 201-214.

MacLeod, C., & Mitchell, G. (2005). Key areas for beaked whales worldwide. *Journal of Cetacean Research and Management, 7*(3), 309.

Mahabub, E. (2008). *Minimum population size of Bryde's whale (Balaenoptera edeni) estimated using photo-identification techniques in the Swatch-of-No-Ground, Bangladesh, during winter seasons 2005-2008. Senior thesis project,*. Independent University, Bangladesh.

Mahakunlayanakul, S. (1996). *Species distribution and status of dolphins in the inner Gulf of Thailand. Ph.D. thesis, Chulalongkorn University, 130 pp.*

Mate, B. R., Gisiner, R., & Mobley, J. (1998). Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. *Canadian Journal of Zoology/Revue Canadien de Zoologie, 76*(5), 863-868.

Mattila, D., Clapham, P., Katona, S., & Stone, G. (1989). Population composition of humpback whales, Megaptera novaeangliae, on Silver Bank, 1984. *Canadian Journal of Zoology, 67*(2), 281-285.

McDonald, M., Mesnick, S., & Hildebrand, J. (2006). Biogeographic characterization of blue whale song worldwide: using song to identify populations. *Journal of cetacean research and management, 8*(1).

Meier, S., Yazvenko, S., Blokhin, S., Wainwright, P., Maminov, M., Yakovlev, Y., et al. (2007). Distribution and abundance of western gray whales off northeastern Sakhalin Island, Russia, 2001-2003. *Environmental monitoring and assessment, 134*(1-3), 107.

Mendez, M., Rosenbaum, H., & Bordino, P. (2008). Conservation genetics of the franciscana dolphin in northern Argentina: population structure, by-catch impacts, and management implications. *Conservation Genetics, 9*(2), 419-435.

Mendez, M., Rosenbaum, H., Yackulic, C., Subramaniam, A., & Bordino, P. (2010). Isolation by environmental distance in mobile marine species: molecular ecology of franciscana dolphins at their southern range. . *Molecular Ecology. In press.*

Merrick, R., & Cole, T. (2007). *Evaluation of northern right whale ship strike reduction measures in the Great South Channel of Massachusetts, NOAA Tech Memo NMFS NE 202*: National Oceanic and Atmospheric Administration.

Michels, K. H., Suckow, A., Breitzke, M., Kudrass, H. R., & Kottke, B. (2003). Sediment transport in the shelf canyon "Swatch of No Ground" (Bay of Bengal). *Deep Sea Research Part II: Topical Studies in Oceanography, 50*(5), 1003-1022.

Minoda, T. (1989). *Oceanographic and biomass changes in the Oyashio Current ecosystem in Kenneth Sherman and Lewis M. Alexander (eds.), Biomass Yields and Geography of Large Marine Ecosystems (Boulder: Westview) AAAS Selected Symposium 111.*

Miyashita, T. (1986). Abundance of Baird's beaked whales off the Pacific coast of Japan. *Rep. Int. Whal. Comm., 36*, 383-386.

Miyashita, T. (1993). *Abundance of dolphin stocks in the western North Pacific taken by the Japanese drive fishery*.

Miyashita, T. (2004). *Cruise report of the common minke whale sighting surveys in the Sea of Okhotsk in 2003*: Paper SC/56/RMP1, available from the International Whaling Commission, Cambridge, UK.

Miyashita, T., & Kato, H. (1993). Population estimate of Baird's beaked whales off the Pacific coast of Japan using sighting data collected by R/V SHUNYO MARU in 1991 and 1992. *IWC/SC/45/SM6*.

Miyashita, T., & Kato, H. (1998). *Recent data on the status of right whales in the NW Pacific Ocean*.

Miyazaki, N., & Amano, M. (1994). Skull morphology of two forms of short-finned pilot whales off the Pacific coast of Japan. *Rep. Int. Whaling Commn, 44*, 499-508.

Miyazaki, N., & Nakayama, K. (1989). Records of cetaceans in the waters of the Amami Islands. *Mem. Natn. Sci. Mus. Tokyo, 22*, 235-249.

Mobley, J., Bauer, G., & Herman, L. (1999). Changes over a ten-year interval in the distribution and relative abundance of humpback whales (Megaptera novaeangliae) wintering in Hawaiian waters. *Aquatic Mammals, 25*, 63-72.

Mobley, J., Spitz, S., Grotefendt, R., Forestell, P., Frankel, A., & Bauer, G. (2001). Abundance of humpback whales in Hawaiian waters: Results of 1993-2000 aerial surveys. *Report to the Hawaiian Islands Humpback Whale National Marine Sanctuary, 26*.

Mori, S. (2005). *Distribution and residency of Indo-Pacific bottlenose dolphins (Tursiops aduncus) in the waters of the Ogasawara (Bonnin) Islands, Japan. In: Sixteenth Biennial Conference on the Biology of Marine Mammals.* Paper presented at the Sixteenth Biennial Conference on the Biology of Marine Mammals, San Diego, CA.

Mullin, K., & Fulling, G. (2003). Abundance of cetatceans in the southern US North Atlantic Ocean during summer 1998. *FISHERY BULLETIN, 101*(3), 603-613.

Mullin, K., & Hoggard, W. (2000). Visual surveys of cetaceans and sea turtles from aircraft and ships. *Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations, 2*, 96-0027.

Mussi, B., Miragliuolo, A., & Bearzi, G. (2002). Short-beaked common dolphins around the island of Ischia, Italy (Southern Tyrrhenian Sea). *European Research on Cetaceans, 16*, 15.

Mustika, P. (2006). *Marine mammals in the Savu Sea (Indonesia): indigenous knowledge, threat analysis and management options.* James Cook University.

Nanbu, Y., Hirose, J., Kubo, N., Kishiro, T., & Shinomiya, A. (2006). Location and number of individuals of Indo-Pacific bottlenose dolphins (Tursiops aduncus) in Kagoshima Bay [Japan]. *Memoirs of Faculty of Fisheries-Kagoshima University (Japan)*.

NMFS. (1994). *Designated Critical Habitat; Northern Right Whale. 59 Federal Register 28793-28834, June 3, 1994*.

NMS. (2009a, March 26, 2008). Cordell Bank Sanctuary: Seamounts And Banks. Retrieved September 2009, from http://www.sanctuarysimon.org/cordell/sections/seamounts/overview.php?sec=sm

NMS. (2009c, March 26, 2008). Gulf of the Farrallones Sanctuary. Retrieved September 2009, from http://www.sanctuarysimon.org/farallones/index.php

Northridge, S. (1996). Seasonal distribution of harbour porpoises in US Atlantic waters. *REPORT-INTERNATIONAL WHALING COMMISSION, 46*, 613-618.

Northrop, J., Cummings, W., & Thompson, P. (1967). 20 Hz signals observed in the central Pacific. *The Journal of the Acoustical Society of America, 42*, 1211.

Notarbartolo di Sciara, G. (2010). Personal Communication. Tethys Research Institute. Milano, Italy.

Notarbartolo-Di-Sciara, G., Zanardelli, M., Jahoda, M., Panigada, S., & Airoldi. (2003). The fin whale Balaenoptera physalus (L. 1758) in the Mediterranean Sea. *Mammal Review, 33*(2), 105-150.

O'Hern, J., & Biggs, D. (2009). Sperm Whale (Physeter macrocephalus) Habitat in the Gulf of Mexico: Satellite Observed Ocean Color and Altimetry Applied to Small-Scale Variability in Distribution. *Aquatic Mammals*, *35*(3), 358-366.

Oleson, E., Calambokidis, J., Barlow, J., & Hildebrand, J. B. W. V. A. A. E. R. I. T. S. C. B. (2007). Blue whale visual and acoustic encounter rates in the Southern California Bight. *Marine Mammal Science, 23*(3), 574-597.

Omura, H., & Sakiura, H. (1956). Studies on the little piked whale from the coast of Japan. *Sci. Rep. Whales Res. Inst. Tokyo, 11*, 1-37.

Overholtz, W., & Link, J. (2007). Consumption impacts by marine mammals, fish, and seabirds on the Gulf of Maine–Georges Bank Atlantic herring (Clupea harengus) complex during the years 1977–2002. *ICES Journal of Marine Science, 64*, 83-96.

Pace, R. M., & Merrick, R. L. (2008). *Northwest Atlantic ocean habitats important to the conservation of North Atlantic right whales (Eubalaena glacialis). US Dept Commerce, Northeast Fish Sci Cent Ref Doc 08-07*. Retrieved from http://www.nefsc.noaa.gov/publications/crd/crd0807/crd0807.pdf.

Palka, D. (1995). *Preliminary cruise report of the spring distribution survey of harbor porpoises in the Mid-Atlantic. Available at NOAA/NMFS/NEFSC, Woods Hole, MA 02543. 7pp.*

Palka, D. (2006). Summer abundance estimates of cetaceans in US North Atlantic navy operating areas. *US Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc*, 06-03.

Palka, D., Orphanides, C., & Warden, M. (2009). Summary of harbor porpoise (Phocoena phocoena) bycatch and levels of compliance in the northeast and mid-Atlantic gillnet fisheries after the implementation of the Take Reduction Plan: 1 January 1999-31 May 2007. *NOAA Technical Memorandum NMFS NE, 212*(89), 02543-01026.

Palka, D., Read, A., Westgate, A., & Johnston, D. (1996). *Summary of current knowledge of harbour porpoises in US and Canadian Atlantic waters. Rep. Int. Whal. Commn 46: 559-565*.

Panigada, S., & Azzellino, A. (2009). *Determinazione degli habitat critici delle specie di cetacei presenti nell'area del Santuario Pelagos (porzione occidentale), ai fini della gestione. Rapporto finale.* : Istituto Tethys.

Panigada, S., Burt, L., Lauriano, G., Pierantonio, N., & Donovan, G. (2009). Winter abundance of striped dolphins (Stenella coeruleoalba) in the Pelagos Sanctuary (north-western Mediterranean Sea) assessed through aerial survey. *Journal of Cetacean Research Management*(SC/61/SM7), 1-10.

Panigada, S., Notarbartolo di Sciara, G., Panigada, M., Airoldi, S., Borsani, J., & Jahoda, M. (2005). Fin whales (Balaenoptera physalus) summering in the Ligurian Sea: distribution, encounter rate, mean group size and relation to physiographic variables. *Journal of Cetacean Research Management, 7*(2), 137-145.

Paterson, R., & Paterson, P. (1984). A study of the past and present status of humpback whales in east Australian waters. *Biological Conservation, 29*(4), 321-343.

Payne, P., & Heinemann, D. (1993). The distribution of pilot whales (Globicephala spp.) in shelf/shelf-edge and slope waters of the Northeastern United States, 1978-1988 In: Biology of Northern Hemisphere Pilot Whales-Reports of the International Whaling Commission, Special issue 14. *IWC, Cambridge, UK*, 51-68.

Pegau, W., Boss, E., & Martínez, A. (2002). Ocean color observations of eddies during the summer in the Gulf of California. *Geophysical Research Letters, 29*(9), 9-1.

Perrin, W., Dolar, M., Amano, M., & Hayano, A. (2003). Cranial Sexual Dimorphism And Geographic Variation In Eraser's Dolphin, Lagenodelphis Hosei. *Marine Mammal Science, 19*(3), 484-501.

Perrin, W., & Hohn, A. (1994). Pan tropical spotted dolphin Stenella attenuata. *Handbook of marine mammals: The first book of dolphins*, 71.

Pet-Soede, L. (2002). *The Solor and Alor islands: Expedition results, data collected during 2 reconnaissance trips; 9-12 September 2001 and 7-19 May, 2002. Report of a joined activity by The Nature Conservancy Southeast Asia Center for Marine Protected Areas and World Wide Fund for Nature Wallacea Bioregional Program.*

Read, A. (1999). Harbour porpoise Phocoena phocoena (Linnaeus, 1758). *Handbook of marine mammals, 6*, 323-355.

Reeves, R., Mckenzie, M., & Smith, T. (2006). History of Bermuda shore whaling, mainly for humpback whales. *Journal of Cetacean Research and Management, 8*(1), 33.

Reilly, S., & Thayer, V. (1990). Blue Whale (Balaenoptera-Musculus) Distribution In The Eastern Tropical Pacific. *Marine Mammal Science, 6*(4), 265-277.

Rendell, L., Cañadas, A., & Mundy, C. (2005). *Scientific Report Balearics Sperm Whale Project 2003-2005*: The Nando Peretti Foundation, One World Wildlife.

Rice, D. (1998). Marine Mammals of the World: Systematics and Distribution, Special Publication Number 4, The Society for Marine Mammalogy: Allen Press, USA. ix+ 231pp.

Rojas-Bracho, L., & Taylor, B. (1999). Risk factors affecting the vaquita (Phocoena sinus). *Marine Mammal Science, 15*(4), 974-989.

Romero, S., Piola, A., Charo, M., & Garcia, C. (2006). Chlorophyll-a variability off Patagonia based on SeaWiFS data. *Journal of Geophysical Research, 111*(C5), C05021.

Rosa, S., Milinkovitch, M., Van Waerebeek, K., Berck, J., Oporto, J., Alfaro-Shigueto, J., et al. (2005). Population structure of nuclear and mitochondrial DNA variation among South American Burmeister's porpoises (Phocoena spinipinnis). *Conservation Genetics, 6*(3), 431-443.

Rosenbaum, H., & Collins, T. (2006). The Ecology, Population Characteristics and Conservation Efforts for Humpback Whales (Megaptera novaeangliae) on Their Wintering Grounds in the Coastal Waters of Gabon. *Bulletin of the Biological Society of Washington*, 425-433.

Rosenbaum, H., Pomilla, C., Mendez, M., Leslie, M., Best, P., Findlay, K., et al. (2009). Population Structure of Humpback Whales from Their Breeding Grounds in the South Atlantic and Indian Oceans.

Rosenbaum, H., Walsh, P., Razafindrakoto, Y., Vely, M., & Desalle, R. (1997). First description of a humpback whale wintering ground in Baie d'Antongil, Madagascar. *Conservation Biology, 11*(2), 308-314.

Rossman, M. (2009). Estimated Bycatch of Small Cetaceans in Northeast US Bottom Trawl Fishing Gear during 2000-2005. *J. Northw. Atl. Fish. Sci., 42*, 77-101.

Rugh, D., Shelden, K., & Schulman-Janiger, A. (2001). Timing of the southbound migration of gray whales. *J. Cetacean Res. Manage, 3*(1), 31-39.

Rutenko, A., Borisov, S., Gritsenko, A., & Jenkerson, M. (2007). Calibrating and monitoring the western gray whale mitigation zone and estimating acoustic transmission during a 3D seismic survey, Sakhalin Island, Russia. *Environmental Monitoring and Assessment, 134*(1), 21-44.

Saraceno, M., Provost, C., & Piola, A. (2005). On the relationship between satellite-retrieved surface temperature fronts and chlorophyll a in the western South Atlantic. *Journal of Geophysical Research-Oceans, 110*(C11), C11016.

Sarin, M., Krishnaswami, S., Dilli, K., Somayajulu, B., & Moore, W. (1989). Major ion chemistry of the Ganga-Brahmaputra river system: Weathering processes and fluxes to the Bay of Bengal. *Geochimica et Cosmochimica Acta, 53*(5), 997-1009.

Scheidat, M., Gilles, A., Kock, K., & Siebert, U. (2008). Harbour porpoise Phocoena phocoena abundance in the southwestern Baltic Sea. *Endangered species research*, 1-9.

Scheninin, A., Kerem, D., & Goffman, O. (2010). Personal Communication. University of Haifa.

Secchi, E., Danilewicz, D., & Ott, P. (2003). Applying the phylogeographic concept to identify franciscana dolphin stocks: implications to meet management objectives. *Journal of Cetacean Research and Management, 5*(1), 61-68.

Selzer, L., & Payne, P. (1988). The distribution of white-sided dolphins (Lagenorhynchus acutus) and common dolphins (Delphinus delphis) vs. environmental features of the continental shelf of the northeastern United States. *Mar. Mammal Sci, 4*, 141-153.

Sergeant, D. (1962). *The biology of the pilot or pothead whale Globicephala melaena (Traill) in Newfoundland waters*: Fisheries Research Board of Canada under the control of the honourable the Minister of Fisheries, Ottawa.

Shirakihara, M., Shirakihara, K., Tomonaga, J., & Takatsuki, M. (2002). A resident population of Indo-Pacific bottlenose dolphins (Tursiops aduncus) in Amakusa, western Kyushu, Japan. *Marine Mammal Science, 18*(1), 30-41.

Siebert, U., Gilles, A., Lucke, K., Ludwig, M., Benke, H., Kock, K., et al. (2006). A decade of harbour porpoise occurrence in German waters--Analyses of aerial surveys, incidental sightings and strandings. *Journal of Sea Research, 56*(1), 65-80.

Smith, B., Ahmed, B., Mowgli, R., & Strindberg, S. (2008). Species occurrence and distributional ecology of nearshore cetaceans in the Bay of Bengal, Bangladesh, with abundance estimates for Irrawaddy dolphins Orcaella brevirostris and finless porpoises Neophocaena phocaenoides. *The Journal of Cetacean Research and Management*, *10*(1), 45-58.

Smith, B., Jefferson, T., Ho, D., Leatherwood, S., Thuoc, C., Andersen, M., et al. (1995). Marine mammals of Vietnam: a preliminary checklist. *Tuyen Tap Nghien Cuu Bien (Collection of Marine Research Works), 6*, 147-176.

Somayajulu, Y., Murty, V., & Sarma, Y. (2003). Seasonal and inter-annual variability of surface circulation in the Bay of Bengal from TOPEX/Poseidon altimetry. *Deep Sea Research Part II: Topical Studies in Oceanography, 50*(5), 867-880.

Sparks, T. (1997). *Distributions of sperm whales along the continental slope in the northwestern and central Gulf of Mexico as determined from an acoustic survey.* Texas A& M University.

Stafford, K., Nieukirk, S., & Fox, C. (2001). Geographic and seasonal variation of blue whale calls in the North Pacific. *Journal of Cetacean Research and Management*, *3*(1), 65-76.

Steele, J. H., Collie, J. S., Bisagni, J. J., Gifford, D. J., Fogarty, M. J., Link, J. S., et al. (2007). Balancing end-to-end budgets of the Georges Bank ecosystem. *Progress In Oceanography, 74*(4), 423-448.

Stone, G., Katona, S., & Tucker, E. J. B. C. (1987). History, migration and present status of humpback whales Megaptera novaeangliae at Bermuda. *42*(2), 133-145.

Strindberg, S., Ersts, P., Collins, T., Sounguet, G., & Rosenbaum, H. (In Press). Line Transect Estimates of Humpback Whale Abundance and Distribution on their Wintering Grounds in the Coastal Waters of Gabon. *Journal of Cetacean Research and Management.*

Subrahmanyam, V., Krishna, K., Ramana, M., & Murthy, K. (2008). Marine geophysical investigations across the submarine canyon (Swatch-of-No-Ground), northern Bay of Bengal. *Current Science, 94*(4), 507-513p.

Tomilin, A. (1967). Mammals of the USSR and adjacent countries. *Vol. IX. Cetacea. Moscow, Soviet Union (English translation, 1967, Israel Program for Scientific Translations, Jerusalem, Israel)*.

Townsend, C. (1935). The distribution of certain whales as shown by logbook records of American whaleships. *Zoologica*, *19*(1), 1-50.

Tyack, P., & Whitehead, H. (1982). Male competition in large groups of wintering humpback whales. *Behaviour*, 132-154.

Van Waerebeek, K., Barnett, L., Camara, A., Cham, A., Diallo, M., Djiba, A., et al. (2004). Distribution, Status, and Biology of the Atlantic Humpback Dolphin, Sousa teuszii (Kukenthal, 1892). *Aquatic Mammals, 30*(1), 56-83.

Vella, A. (2005). Common dolphin *Delphinus delphis* research and conservation requirements in the Central Mediterranean around the Maltese Islands. In K. Stockin, A. Vella, P.G.H. Evans. Common dolphins: current research, threats and issues. *ECS Newsletter N. 45, Special Issue July 2005,* 4-12.

Verfuß, U., Honnef, C., Meding, A., Dähne, M., Mundry, R., & Benke, H. (2007). Geographical and seasonal variation of harbour porpoise (Phocoena phocoena) presence in the German Baltic Sea revealed by passive acoustic monitoring. *Journal of the Marine Biological Association of the UK, 87*(01), 165-176.

Vigness-Raposa, K., Kenney, R., Gonzalez, M., & August, P. (2009). Spatial patterns of humpback whale (Megaptera novaeangliae) sightings and survey effort: Insight into North Atlantic population structure. *Marine Mammal Science, 26*(1), 161-175.

Wada, S. (1988). Genetic differentiation between two forms of short-finned pilot whales off the Pacific coast of Japan. *Sci Rep Whales Res Inst, 39*, 91-101.

Walsh, P., Fay, J., Gulick, S., & Sounguet, G. (2000). Humpback whale activity near Cap Lopez, Gabon. *Journal of Cetacean Research and Management, 2*(1), 63-68.

Wang, J., & Yang, S. (2007). *An identification guide to the dolphins and other small cetacean of Taiwan.*: Jen Jen Publishing Co., Ltd.

Wang, P. (1999). Chinese cetaceans. *Hong kong: Ocean Enterprises Ltd*.

Waring, G., Josephson, E., Fairfield-Walsh, C., & Maze-Foley, K. (2009). US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments--2008. *NOAA Tech Memo NMFS NE 210, 210*(440), 02543-01026.

Watkins, W., Daher, M., Reppucci, G., George, J., Martin, D., DiMarzio, N., et al. (2000). Seasonality and distribution of whale calls in the North Pacific. *OCEANOGRAPHY-WASHINGTON DC-OCEANOGRAPHY SOCIETY-, 13*(1), 62-67.

Weir, C. (2006a). First confirmed records of Clymene dolphin, Stenella clymene (Gray, 1850), from Angola and Congo, south-east Atlantic Ocean. *African Zoology, 41*(2), 297-300.

Weir, C. (2006b). Short Communication Sightings of beaked whales (Cetacea: Ziphiidae) including first confirmed Cuvier's beaked whales Ziphius cavirostris from Angola. *African Journal of Marine Science, 28*(1), 173-175.

Weir, C. (2007). Occurrence and distribution of cetaceans off Northern Angola, 2004/05. *The Journal of Cetacean Research and Management, 9*(3).

Whitehead, H., Gowans, S., Faucher, A., & McCarrey, S. (1997). Population analysis of northern bottlenose whales in the Gully Nova Scotia. *Marine Mammal Science, 13*(2), 173-185.

Whitehead, H., & Moore, M. (1982). Distribution and movements of West Indian humpback whales in winter. *Canadian Journal of Zoology, 60*(9), 2203-2211.

Wimmer, T., & Whitehead, H. (2004). Movements and distribution of northern bottlenose whales, Hyperoodon ampullatus, on the Scotian Slope and in adjacent waters. *Canadian Journal of Zoology, 82*(11), 1782-1794.

Winn, H. (1982). A characterization of marine mammals and turtles in the Mid-and North Atlantic areas of the US outer continental shelf. *Final report. Sponsored by the Bureau of Land Management under contract AA551-CT8-48. 450pp*.

Yamada, T. (2009). *Balaenpotera omurai Wada, Oishi & Yamada, 2003. Pages 330-331, In: The Wild Mammals of Japan.* Kyoto: Shoukadoh Book Sellers.

Yen, P. P. W., Sydeman, W. J., & Hyrenbach, K. (2004). Marine bird and cetacean associations with bathymetric habitats and shallow- water topographies: implications for trophic transfer and conservation. *Journal of Marine Systems, 50*(1-2), 79-99.

Yoshida, H., Shirakihara, K., Kishino, H., & Shirakihara, M. (1997). A population size estimate of the finless porpoise, Neophocaena phocaenoides, from aerial sighting surveys in Ariake Sound and Tachibana Bay, Japan. *Researches on Population Ecology, 39*(2), 239-247.

Zhou, K. (2002). Marine mammal research and conservation in China. *Fisheries Science, 68*((Supplement 1)), 244-247.

Zhou, K. (2004). Cetacea Carnivora: Phocoidea, Sirenia. Fauna Sinica, Mammal 9:vi, 326.

Zhou, K., Leatherwood, S., & Jefferson, T. (1995). Records of small cetaceans in Chinese waters: a review. *Asian Marine Biology*, *12*, 119-139.

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APPENDIX D-7: RECOMMENDATIONS FOR MARINE MAMMAL OFFSHORE BIOLOGICALLY IMPORTANT AREAS (OBIAS) FOR THE SURVEILLANCE TOWED ARRAY SENSOR SYSTEM LOW FREQUENCY ACTIVE (SURTASS LFA) SONAR, REVISED 21 SEPTEMBER 2010

Recommendations for Marine Mammal Offshore Biologically Important Areas (OBIAs) for the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar

National Marine Fisheries Service
Office of Protected Resources
21 September 2010

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Table 1 – NMFS' Classification Methodology for OBIA Recommendations

Level	Level Description for High Density, Foraging, Breeding/Calving, Migration, or Small Distinct Populations	Level Description Boundary Consideration
0	Information not provided or information presented does not meet NMFS' definition of the corresponding OBIA criteria or the OBIA criteria are not applicable.	SME did not provide boundary information.
1	Clear justification (qualitative or quantitative) for corresponding OBIA criteria is not available; or the SME did not provide sufficient detail to NMFS for criteria evaluation; or for high density specifically, the SME provided strong abundance/presence information, but without the comparative information that supports *high* density.	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.
2	Designation inferred from analyses conducted for purposes other than quantifying the corresponding OBIA criteria. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.	Proposed boundary inferred from analyses conducted for purposes other than quantifying the boundary. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.
3	Designation inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at investigating and supporting the corresponding OBIA criteria. Information presented from a single source or is generally imprecise (e.g., CV => 30%).	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at investigating and supporting the proposed boundary.
4	Designation inferred from peer-reviewed analyses or surveys specifically aimed at investigating and supporting the corresponding OBIA criteria. Information presented is from multiple sources or is generally precise (e.g., CV < 30%).	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973).

Table 2 - List of Recommendations and NMFS' Classification of Supporting Data

Key

High Density – HD | Foraging – F | Breeding / Calving – BC
Migration – M | Critical Habitat – CH | Small Distinct Population - SD

Name	HD	F	BC	M	CH	SDP	Highest Rank for All Species	Highest Rank for LF Specialists
Northern Bay of Bengal and Swatch-of-No-Ground	1	2	2	0	0	4	4	2
Northern Bay of Bengal and Swatch-of-No-Ground (Head of Song)	0	0	2	0	0	0	-	2
Central California National Marine Sanctuaries	4	4	0	4	0	0	4	4
Coastal Waters of Gabon, Congo and Equatorial Guinea	1	1	4	4	0	2	4	4
Coastal Waters off Madagascar	1	1	4	1	0	0	4	4
Georges Bank	3	4	0	4	0	0	4	4
Great South Channel	0	3	0	0	4	0	4	4
Okhotsk Sea	0	4	0	2	0	0	4	4
Patagonian Shelf Break	0	4	0	0	0	0	4	4
Roseway Basin Right Whale Conservation Area	0	4	0	0	0	0	4	4
Silver Bank and Navidad Bank	0	0	4	0	0	0	4	4
Southeastern U.S. Right Whale Seasonal Habitat	0	0	4	0	4	0	4	4
Southern California Bight	0	4	0	4	0	0	4	4
Southern Right Whale Seasonal Habitat	0	0	4	0	0	0	4	4
Bonney Upwelling	0	3	0	0	0	0	3	3
Costa Rica Dome	0	3	0	0	0	0	3	3
Great Barrier Reef Between 16°E and 21°S	0	0	3	0	0	0	3	3
Madagascar Plateau, Madagascar Ridge, Walters Shoal	1	3	0	3	0	2	3	3
Ligurian-Corsican-Provençal Basin And Western Pelagos Sanctuary	0	3	0	0	0	0	3	3
Penguin Bank	3	0	3	0	0	0	3	3
Piltun and Chayvo Offshore Feeding Grounds	0	3	0	1	0	0	3	3

Name	HD	F	BC	M	CH	SDP	Highest Rank for All Species	Highest Rank for LF Specialists
Area in the Ombai Strait in the Savu Sea Marine Protected Area	0	2	0	2	0	0	2	2
Fairweather Grounds, Southeast Alaska	0	2	0	0	0	0	2	2
Felibres Hills, Calypso Hills, Spinola Spur, and Montpelier Canyon	2	2	2	0	0	0	2	2
Northwest of Challenger Bank	0	2	0	2	0	0	2	2
Olympic Coast: The Prairie, Barkley Canyon, and Nitnat Canyon	0	2	0	0	0	0	2	2
Southern Gulf of California	2	0	0	0	0	0	2	1
Barcelona Canyon, Tarragona Canyon, Mallorca Chanel, Pituisas Canyon	2	2	2	0	0	0	2	1
Caprera Canyon, Giglio Ridge, Oblia Terrace – Southeast of Pelagos Sanctuary	2	0	0	0	0	0	2	1
Exclusion for the East China Sea	1	0	0	0	0	0	1	1
Exclusion for the West Philippine Sea	1	0	0	0	0	0	1	1
Mediterranean Sea West of 10° E Ligurian Sea to Gibralter Strait	2	0	0	0	0	0	1	1
Pelagos Cetacean Sanctuary	2	0	0	0	0	0	2	1
Peñiscola Canyon, Valencia Basin, Benidorm Canyon, Alicante Canyon, Águilas Seamount	2	0	0	0	0	0	2	1
Sardinian Seamount, Comino Trough, Sardinia, Corsica Trough	2	2	2	0	0	0	2	1
Song of the Whale Surveys - Eastern Mediterranean	1	0	0	0	0	0	1	1
Area around Ischia Island and Regno di Nettuno Marine Protected Area	2	1	3	0	0	0	3	0
Area around Quarqannah Island	0	0	0	0	0	0	0	0
Area in the Northern Adriatic Sea	2	2	3	0	0	0	3	0
Area Malta Island and Malta Plateau	0	0	0	0	0	0	0	0
Area off Eastern Sicily, East of Messina Canyon	2	0	0	0	0	0	2	0
Area off of Southwest Greece and Crete, Ptolemy Mountains, Cretan-Rhodes Ridge	2	2	2	0	0	0	2	0
Area off the Gaza Strip and the Western Coast of Israel	1	0	0	0	0	0	1	0

Name	HD	F	BC	M	CH	SDP	Highest Rank for All Species	Highest Rank for LF Specialists
Avenzar Bank, Câbliers Bank, and El Mansour Seamount	1	2	2	0	0	0	2	0
Beaked Whale Habitat in the Coastal Waters off California, Washington, and Oregon	2	0	0	0	0	0	2	0
Buenos Aires Province Coastal Area	1	2	2	0	0	2	2	0
Canary Islands Cetacean Marine Sanctuary	1	0	0	0	0	0	1	0
Cape Hatteras Special Research Area	3	3	0	0	0	0	3	0
Continental Slope of the Northern Gulf of Mexico	1	1	0	0	0	0	1	0
Cross Seamount	0	3	0	0	0	0	3	0
Djibouti Bank, Ville de Djibouti Bank, and Alborán Channel	1	2	2	0	0	0	2	0
Dogger Bank	1	0	0	0	0	0	1	0
Exclusion around Japan and the Ryukyu Islands	2	0	0	0	0	0	2	0
Exclusion around Taiwan	0	0	0	0	0	0	0	0
Exclusion around Wake Island	0	0	0	0	0	0	0	0
Exclusion for the North Philippine Sea	0	0	0	0	0	0	0	0
Exclusion in the South China Sea	1	0	0	0	0	0	1	0
Gulf of Alaska Steller Sea Lion Critical Habitat	0	0	0	0	4	0	4	0
Gulf of Thailand	2	0	1	0	0	3	3	0
Harbor Porpoise Take Reduction Management Areas	3	3	0	3	0	0	3	0
Komodo National Park, Biosphere Reserve	2	0	0	0	0	0	2	0
Marseille Canyon, Cassis Canyon, Felibres Hill, Alabe Hill, Barcelona Canyon	2	2	0	0	0	0	2	0
North Alboran Sea, Gulf of Vera, Southern Almeria	1	2	2	0	0	0	2	0
Pommeranian Bay, Adler Ground, and Western Ronne Bank	0	0	2	0	0	0	2	0
Shortland Canyon and Haldimand Canyon	3	3	0	0	0	0	3	0
Southern Almería, Seco de los Olivos Seamount, Alborán Island, Águilas Seamount	2	2	2	0	0	0	2	0
Southwest Mediterranean	1	2	2	0	0	0	2	0

Name	HD	F	BC	M	CH	SDP	Highest Rank for All Species	Highest Rank for LF Specialists
Sylt Outer Reef	1	0	3	0	0	0	3	0
The Gully Marine Protected Area	4	3	0	0	0	0	4	0
The Sea of Japan	2	0	0	0	0	0	2	0
Total Exclusion in the Gulf of Tonkin	0	0	0	0	0	0	0	0
Total Exclusion within the Yellow Sea / East China Sea	0	0	0	0	0	0	0	0
Tristan da Cunha Cetacean Sanctuary	1	0	0	0	0	0	1	0
Vaquita Habitat in the Northern Gulf of California	0	0	0	0	0	4	4	0

IUCN Marine Region 3: Mediterranean Sea

Southwest Mediterranean Sea (South of Sardinia to Alborán Sea - IFAW Survey)

Proposed Criteria Submitted by SME or NMFS:	2A: High Density 2B: Foraging Area 2B: Breeding Area 2B: Migration Corridor
Species of Concern:	Sperm whale (*Physeter macrocephalus*)
Proposed Boundary Consideration: *Basis: G. Notobartolo di Sciara (GNdS) Submission Number 1*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- One of the areas with highest sperm whale densities[11] in the Mediterranean. Whales feed and breed here. Considering that there is some genetic exchange between Mediterranean and Atlantic sperm whales, the Alborán Sea can be considered a migration corridor between the two regions (Lewis, 2010).
- On the assumption that g(0)=1, standard DISTANCE analysis gives an abundance estimate for the survey block of 561 animals (Lewis, 2010).

Number of Supporting Documents[12]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers. Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt. Report or NGO Report	Note/ Abstracts / Proceedings
0	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	2- Eligible	0 - Not Applicable
Breeding / Calving	2- Eligible	0 - Not Applicable
Migration Route	2- Eligible[13]	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct	0 - Not Applicable	0 - Not Applicable

11 Statement based on expert opinion.
12 Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
13 The SME did not select this criterion for consideration. However, NMFS believes that this area may qualify for consideration based on information in the background provided or in the supporting documents.

Population		

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

North Alborán Sea, Gulf of Vera, Southern Almeria (Spain)

Proposed Criteria Submitted by SME or NMFS:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Short-Beaked Common Dolphin (*Delphinus delphis);* Striped dolphins (*Stenella coeruleoalba*)
Proposed Boundary Consideration: *Basis: GNdS Submission Number 2*	SME provided a KMZ file. Area proposed covers coast to 30 nm seaward of the Andalusian Coast. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	Year-round.

Background Provided by SME

- Paper describes mostly short-beaked common dolphins; however this and other studies clearly emphasize importance of area for: a) high densities[14] of a number of odontocete species, which feed and breed there year-round (Cañadas & Hammond, 2008).
- Area covered in map is only the one which was surveyed: critical habitat of described species certain to extend much further to the south, possibly all the way to the Moroccan and Algerian coasts.
- Ana Cañadas and colleagues have published during the past decade or so a large number of papers detailing the importance of the N. Alboran Sea for a number of odontocete species. These include long-finned pilot whales (*Globicephala melas*), Risso's dolphins (*Grampus griseus*), Cuvier's beaked whales (*Ziphius cavirostris*), common bottlenose dolphins (*Tursiops truncates*). (Notarbartolo di Sciara, 2010).

Number of Supporting Documents[15]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers. Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt. Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	2- Eligible	0 - Not Applicable
Breeding / Calving	2- Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

14 Statement based on expert opinion.

15 Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Avenzar Bank, Câbliers Bank, and El Mansour Seamount - MED 09 Surveys (Spain)

Proposed Criteria Submitted by SME or NMFS:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Cuvier's beaked whale (*Ziphius cavirostris*); Long-finned pilot whale (*Globicephala melas*); Risso's dolphin (*Grampus griseus*); Common dolphin (*Delphinus delphis*); Striped dolphin (*Stenella coeruleoalba*)
Proposed Boundary Consideration: *Basis: GNdS SubmissionNumber 3*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density[16] area for species mentioned.
- Breeding and feeding[17] known to occur in the area for all of them.
- Alborán East: area covered by [Med-09] cruise, where a very large number of sightings were made (in 45 hours of effort: 67 Cuvier's beaked whales, 168 long-finned pilot whales, 89 Risso's dolphins, 304 short-beaked common dolphins, 870 striped dolphins, plus a number of mixed-species groups and unidentified cetaceans) is certainly much smaller than the area actually used by the concerned populations (Anon., 2010).

Number of Supporting Documents[18]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers. Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt. Report or NGO Report	Note/ Abstracts / Proceedings
0	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	2- Eligible	0 - Not Applicable
Breeding / Calving	2- Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

16 Statement based on expert opinion.

17 Statement based on expert opinion.

18 Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Djibouti Bank, Ville de Djibouti Bank, and Alborán Channel - MED 09 Surveys (Spain)

Proposed Criteria Submitted by SME or NMFS:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Cuvier's beaked whale (*Ziphius cavirostris*); Long-finned pilot whale (*Globicephala melas*); Risso's dolphin (*Grampus griseus*); Common dolphin (*Delphinus delphis*); Striped dolphin (*Stenella coeruleoalba*); Bottlenose dolphin (*Tursiops truncatus*)
Proposed Boundary Consideration: *Basis: GNdS Submission Number 4*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density area[19] for species mentioned. Breeding and feeding[20] known to occur in the area for all of them.
- Alborán West: area covered by cruise, where a very large number of sightings were made (in 60 hours of effort: 56 Cuvier's beaked whales, 71 long-finned pilot whales, 38 Risso's dolphins, 222 short-beaked common dolphins, 550 striped dolphins, plus a number of mixed-species groups and unidentified cetaceans) is certainly much smaller than the area actually used by the concerned populations (Anon., 2010; Notarbartolo di Sciara, 2010).

Number of Supporting Documents[21]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers. Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	2- Eligible	0 - Not Applicable
Breeding / Calving	2- Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[19] Statement based on expert opinion.
[20] Statement based on expert opinion.
[21] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Sardinian Seamount, Comino Trough, Sardinia/Corsica Trough - MED 09 Surveys (Sardinia/Italy)

Proposed Criteria Submitted by SME or NMFS:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Fin whale (*Balaenoptera physalus*); Sperm whale (*Physeter macrocephalus*); Cuvier's beaked whale (*Ziphius cavirostris*); Bottlenose dolphin (*Tursiops truncatus*); Common dolphin (*Delphinus delphis*); Striped dolphin (*Stenella coeruleoalba*)
Proposed Boundary Consideration: *Basis: GNdS Submission Number 5*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Tyrrhenian Sea: area covered by cruise, where a very large number of sightings[22] were made (in 53 hours of effort: 27 fin whales, 24 sperm whales, 12 Cuvier's beaked whales, 4 bottlenose dolphins, 45 short-beaked common dolphins, 366 striped dolphins, plus a number of mixed-species groups and unidentified cetaceans) is certainly much smaller than the area used by the concerned populations (Anon., 2010).
- However, a 1993 study (Notarbotolo di Sciara et al., 1993) reported that fin whales were occasionally observed in the Tyrrhenian Sea, but that their concentration was greatest in the Ligurian-Corsican Sea.
- Breeding and feeding[23] known to occur in the area for all of them.

Number of Supporting Documents[24]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers. Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt. Report or NGO Report	Note/ Abstracts / Proceedings
0	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Rank for All Species	Rank for LF Hearing Specialists
High Density	2 - Eligible	1 - Not Eligible
Foraging Area	2- Eligible	0 - Not Applicable
Breeding / Calving	2- Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

22 Proposed criteria for high density based on expert opinion.
23 Statement based on expert opinion.
24 Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Barcelona Canyon, Tarragona Canyon, Mallorca Chanel, Pituisas Canyon (Spain and France)

Proposed Criteria Submitted by SME or NMFS:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Bottlenose dolphin (*Tursiops truncatus*); Sperm whale (*Physeter macrocephalus*); Striped dolphin (*Stenella coeruleoalba*); Fin whale (*Balaenoptera physalus*); Risso's dolphin (*Grampus griseusz*); Long-finned pilot whale (*Globicephala melas*); Common dolphin (*Delphinus delphis*); Unidentified beaked whales
Proposed Boundary Consideration: *Basis: GNdS Submission No. 6 and 7*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Area contains critical habitat[25] of the species (i.e., *Tursiops*) which feeds and breeds there (Forcada, Gazo, Aguilar, Gonzalvo, & Fernández-Contreras, 2004; Notarbartolo di Sciara, 2010).
- Breeding and feeding[26] known to occur in the area for at least all odontocetes.
- Large number of sightings of different species made during two summer cruises in 2003 and 2004 testify importance of Balearic waters for cetacean ecology and biodiversity (Notarbartolo di Sciara, 2010; Rendell, Cañadas, & Mundy, 2005).

Number of Supporting Documents[27]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible[28]	1 - Not Eligible
Foraging Area	2- Eligible	0 - Not Applicable
Breeding / Calving	2- Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[25] Area does not qualify as critical habitat as defined in the NMFS classification schema.
[26] Statement based on expert opinion.
[27] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[28] Proposed criteria for high density based on expert opinion.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance. .

Peñiscola Canyon, Valencia Basin, Benidorm Canyon, Alicante Canyon, Águilas Seamount (Spain)

Proposed Criteria Submitted by SME or NMFS:	2A: High Density
Species of Concern:	Fin whale (*Balaenoptera physalus*); Sperm whale (*Physeter macrocephalus*); Cuvier's beaked whale (*Ziphius cavirostris*); Bottlenose dolphin (*Tursiops truncatus*); Common dolphin (*Delphinus delphis*) Striped dolphin (*Stenella coeruleoalba*); Risso's dolphin (*Grampus griseus*); Long-finned pilot whale (*Globicephala melas*); Unidentified beaked whale
Proposed Boundary Consideration: *Basis:* *GNdS Submission Number 8*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density[29] area for species mentioned. However, a 1993 study (Notarbotolo di Sciara, et al., 1993) reported that fin whales concentrations were greatest in the Ligurian-Corsican Sea.
- Population estimates performed with aerial and vessel surveys demonstrated the high values of the study area for striped dolphins (mean abundance 15,778), bottlenose dolphins (1,333) and Risso's dolphins (493) (Gómez de Segura, Crespo, Pedraza, Hammond, & Raga, 2006; Notarbartolo di Sciara, 2010).

Number of Supporting Documents[30]

Peer-Reviewed Article(s)	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible[31]	1 - Not Eligible
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

[29] Statement based on expert opinion.
[30] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[31] Proposed criteria for high density based on expert opinion.

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Southern Almería, Seco de los Olivos Seamount, Alborán Island, Águilas Seamount (Spain)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Sperm whale (*Physeter macrocephalus*); Cuvier's beaked whale (*Ziphius cavirostris*); Bottlenose dolphin (*Tursiops truncatus*); Common dolphin (*Delphinus delphis*); Striped dolphin (*Stenella coeruleoalba*); Risso's dolphin (*Grampus griseus*); Long-finned pilot whale (*Globicephala melas*); Unidentified beaked whale
Proposed Boundary Consideration: *Basis: GNdS Submission Number 9*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density[32] area for species mentioned. Breeding and feeding[33] known to occur in the area for all of them.
- “The results identified areas that are important for a number of cetacean species, thus illustrating the potential for MPAs to improve cetacean conservation generally in the Alborán Sea, a region of great importance for supporting biodiversity and ecological processes in the wider Mediterranean Sea (Cañadas, Sagarminaga, De Stephanis, Urquiola, & Hammond, 2005).”

Number of Supporting Documents[34]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS’ Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	2 - Eligible	0 - Not Applicable
Breeding / Calving	2 - Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[32] Statement based on expert opinion.
[33] Statement based on expert opinion.
[34] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Felibres Hills, Calypso Hills, Spinola Spur, and Montpelier Canyon (France, Italy, Monaco)

Potential Criteria:	2A: High Density 2B: Critical Habitat 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Striped dolphin (*Stenella coeruleoalba*); Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: *Basis: GNdS Submission No. 10 and 12*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Area (established as a cetacean sanctuary (i.e., Pelagos) contains critical habitat[35] for a number of cetacean species, in particular the two listed here (striped dolphin and fin whale), which are known to feed and breed in the area.
- In a recent aerial survey, unpublished at present, fin whale numbers seen in 2009 are smaller than in previous years, but still substantive. Whales likely to have moved wider and ranging beyond Sanctuary waters. High density, feeding and breeding area[36].
- This area coincides with distribution detected during 1992 survey, described in Forcada J., Notarbartolo di Sciara G., Fabbri F. (1995). Abundance of fin whales and striped dolphins summering in the Corso-Ligurian Basin. (Forcada, et al., 1995).

Number of Supporting Documents[37]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	2 - Eligible
Foraging Area	2 - Eligible	2 - Eligible
Breeding / Calving	2 - Eligible	2 - Eligible
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[35] Area does not qualify as critical habitat as defined in the NMFS classification schema.
[36] Statement based on expert opinion.
[37] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Mediterranean Sea West of 10°E–Ligurian Sea to Gibralter Strait (France, Italy, Monaco)

Potential Criteria:	2A: High Density
Species of Concern:	Striped dolphin (*Stenella coeruleoalba*); Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: *Basis: GNdS Submission Number 11*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Study indicates locations of distributional "hot spots" for both species in a large portion of the west Mediterranean.
- See also: Forcada J., Aguilar A., Hammond P.S., Pastor X., Aguilar R. 1994. Distribution and numbers of striped dolphins in the western Mediterranean Sea after the 1990 epizootic outbreak. Marine Mammal Science 10(2):137-150 (Forcada, Aguilar, Hammond, Pastor, & Aguilar, 2006).
- This area coincides with distribution detected during 1992 survey, described in Forcada J., Notarbartolo di Sciara G., Fabbri F. 1995 (1995). Abundance of fin whales and striped dolphins summering in the Corso-Ligurian Basin.

Number of Supporting Documents[38]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible[39]	1 - Not Eligible
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

[38] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[39] Proposed criteria for high density based on expert opinion.

Marseille Canyon, Cassis Canyon, Felibres Hill, Alabe Hill, Barcelona Canyon (France, Italy)

Potential Criteria:	2A: High Density 2B: Foraging Area
Species of Concern:	Sperm whale (*Physeter macrocephalus*)
Proposed Boundary Consideration: *Basis: GNdS Submission Number 13*	SME provided a KMZ file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density, feeding area[40].
- Area stops at Lat 39° 35′ however there is just a small distance to cover to merge into area No. 1 (i.e., the Southwest Mediterranean - South of Sardinia to Alboran Sea - IFAW Survey recommendation (Anon., 2010)) so we should presume the two are contiguous .

Number of Supporting Documents[41]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	1	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	2 - Eligible	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

[40] Statement based on expert opinion.
[41] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Pelagos Cetacean Sanctuary (France, Italy, Monaco)

Potential Criteria:	2A: High Density
Species of Concern:	Striped dolphin (*Stenella coeruleoalba*); Sperm whale (*Physeter macrocephalus*); Fin whale (*Balaenoptera physalus*); Long-finned pilot whale (*Globicephala melas*); Risso's Dolphin (*Grampus griseus*); Cuvier's beaked whale (*Ziphius cavirostris*); Bottlenose dolphin (*Tursiops truncatus*); Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis: GNdS Submission No. 14 and 15*	SME provided a KMZ file.
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High densities. High density confirmed also during winter[42].
- A total of 131 cetacean sightings of were made: striped dolphins (n=114), common bottlenose dolphins (7), fin whales (1), sperm whales (1), Cuvier's beaked whales (1) and unidentified small dolphins (7). Uncorrected striped dolphin population size was estimated to be 19,578 (% CV=19.2; 95% C.I.=12,318 – 27,039), with a density of 0.2218 individuals km-1 (%CV=19.23; 95% C.I.=0.1395-0.3063) (S. Panigada, Burt, Lauriano, Pierantonio, & Donovan, 2009).
- Panigada and Azzelino's (2009) report to the Italian Ministry of the environment, in Italian contains a summary of almost two decades of data, with spatial modeling to describe habitat for several species.

Number of Supporting Documents[43]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	1 - Not Eligible
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973).

[42] Statement based on expert opinion.
[43] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Caprera Canyon, Giglio Ridge, Oblia Terrace – Southeast of Pelagos Sanctuary (Italy)

Potential Criteria:	2A: High Density
Species of Concern:	Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis:* *GNdS Submission Number 16*	SME provided a KMZ file.
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High densities[44].
- Detected hitherto unsuspected high densities of fin whales (but also striped dolphin and common dolphin) outside of boundaries of Pelagos Sanctuary, to the southeast (Arcangeli et al., 2009).

Number of Supporting Documents[45]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book, Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	0	1

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	1 - Not Eligible
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

44 Statement based on expert opinion.
45 Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Area around Ischia Island and Regno di Nettuno Marine Protected Area (Italy)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding Area
Species of Concern:	Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis: GNdS Submission Number 17*	SME provided a KMZ file. *Note that many areas (Napoli Canyon, Ponza-Salerno Terrace) are within 12 nm of island coastlines.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- One of the few remaining strongholds for the species in the Mediterranean, outside of the Alborán Sea.
- An MPA (i.e., Ischia – Regno di Nettuno MPA) was established by the Italian Government in large part to protect cetaceans (these also include sperm whales, frequenting the Cuma Canyon north of the island of Ischia).
- 46 Recognizable individuals have been catalogued, 19 of these re-sighted in different years, suggesting significant levels of site fidelity. Breeding activities are often observed, and calves are always present in one or more of the group sub-units. Sighted groups are relatively large (mean=65.5, SD=23.94, n=41, range 35–100 individuals) and often observed in association with striped dolphins (*Stenella coeruleoalba*), particularly during surface feeding targeting shoaling prey (Mussi, Miragliuolo, & Bearzi, 2002).

Number of Supporting Documents[46]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible[47]	0 - Not Applicable
Foraging Area	1 - Not Eligible	0 - Not Applicable
Breeding / Calving	3 - Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[46] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[47] Proposed criteria for high density based on expert opinion.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973).

Area off Eastern Sicily, East of Messina Canyon (Sicily, Italy)

Potential Criteria:	2A: High Density
Species of Concern:	Sperm whale (*Physeter macrocephalus*)
Proposed Boundary Consideration: *Basis: GNdS Submission Number 20*	SME provided a KMZ file. *Note that many areas are within 12 nm of island coastlines except for a small portion.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High densities[48].
- "...marine biologists from the University of Pavia piggy-backed a sea mammal–monitoring experiment on [an] array [of four sensors off Sicily to see whether background noise is low enough to allow for acoustic detection of neutrinos]. The ensuing log, which is still being analyzed by both biologists and physicists, indicates hundreds of sperm-whale transits per year over an area of about 1,000 square kilometers" (Holden, 2007).

Number of Supporting Documents[49]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	0	1

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

[48] Statement based on expert opinion.
[49] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Area around Quarqannah Island (Tunisia)

Potential Criteria:	2B: Critical Habitat
Species of Concern:	Bottlenose dolphin (*Tursiops truncatus*)
Proposed Boundary Consideration: *Basis: GNdS Submission Number 21*	SME provided a KMZ file. *Note that many areas are within 12 nm of coastline.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Presence of critical habitat[50].
- "La densité du Grand dauphin a été estimée à 0,19 animaux/km², avec un coefficient de variation de 33%. L'effectif estimé pour l'ensemble de la zone étudiée est de 3977 dauphins, avec un intervalle de confiance relativement large, de 1982 à 7584 animals."
- **Translation from Abstract:** This campaign, ASPIS 2003, concerned the zone of the 15 MN of Kélibia to Zarzis, in the east and the south of the country. The density of the common bottlenose dolphin was 0.19 per km^2 with a CV of 33%. The valued strength for the whole of the studied zone is 3,977 dolphins, with a relatively large confidence interval, of 1,982 to 7,584 animals. The relative abundance of the bottlenose dolphin was 0.1383 individuals per km^2. The species was however abundant in the Monastirs-Chebba and the Gabes Gulf zones. In the zone of the Cap Bon, the relative abundance was relatively weak compared to the other zones (Ben Naceur et al., 2004).

Number of Supporting Documents[51]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Eligible	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[50] Area does not qualify as critical habitat as defined in the NMFS classification schema.
[51] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

Area Malta Island and Malta Plateau (Malta)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding/Calving Area
Species of Concern:	Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis: GNdS Submission Number 23*	SME provided a KMZ file. *Note that many areas are within 12 nm of coastline.* *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Vella's (2005) preliminary study, detected important presence of species and recommends further research/conservation effort.

Number of Supporting Documents[52]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	0	1

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Eligible[53]	0 - Not Applicable
Foraging Area	0 - Not Eligible[54]	0 - Not Applicable
Breeding / Calving	0 - Not Eligible[55]	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

[52] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[53] Proposed criteria for high density based on expert opinion.
[54] Proposed criteria for foraging based on expert opinion.
[55] Proposed criteria for breeding / calving based on expert opinion.

Area in the Northern Adriatic Sea (Italy, Greece, Slovenia)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding/Calving Area
Species of Concern:	Bottlenose dolphin (*Tursiops truncatus*)
Proposed Boundary Consideration: *Basis: GNdS Submission No. 24 and 25*	SME provided a KMZ file. *Note that many areas are within 12 nm of coastline.* *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Moderate density area; *Tursiops* is the only cetacean sighted.
- "…a total of 156 sightings between 1988 and 2007. Encounter rates ranged between 0.42 and 1.67 groups/100 km of effort (Bearzi et al., 2009).
- High density, breeding/calving area, foraging grounds (i.e., off the Slovenian coast)[56].
- "…A total of 120 sightings ...101 dolphins identified" between 2002 and 2008. High rate of site fidelity. Offspring present in 53.3% of groups. Annual mark-recapture estimate 0.069 dolphins/km^2 (Genov, Kotnjek, Lesjak, Hace, & Fortuna, 2008).

Number of Supporting Documents[57]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	2 - Eligible	0 - Not Applicable
Breeding / Calving	3 - Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

[56] Proposed criteria for high density, foraging, breeding and calving based on expert opinion.
[57] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Area off of Southwest Greece and Crete (Ptolemy Mountains, Cretan-Rhodes Ridge) (Greece)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Breeding/Calving Area
Species of Concern:	Sperm whale (*Physeter macrocephalus*); Cuvier's beaked whale (*Ziphius cavirostris*)
Proposed Boundary Consideration: *Basis:* *GNdS Submission Number 30*	SME provided a KMZ file. *Note that some areas are within 12 nm of coastline.* *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- High density, breeding/calving area, foraging grounds[58].
- Frantzis and colleagues have collected vast amounts of additional data during yearly cruises, which however remain unpublished. Data include information on another deep-diving species *Ziphius cavirostris*, which also apparently has important habitat in the area (Frantzis et al., 1999).

Number of Supporting Documents[59]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	1	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	2 - Eligible	0 - Not Applicable
Breeding / Calving	2 - Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

58 Statement based on expert opinion.
59 Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Area off the Gaza Strip and the Western Coast of Israel (Palestine, Israel)

Potential Criteria:	2A: High Density
Species of Concern:	Common dolphin (*Delphinus delphis*)
Proposed Boundary Consideration: *Basis:* *GNdS Submission Number 35*	SME provided a KMZ file. *Note that some areas are within 12 nm of coastline.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Hitherto unsuspected presence in large groups.
- Several sightings of large groups in recent years, contrasting with previous absence of the species from the area in the authors' collective experience (Scheninin, Kerem, & Goffman, 2010).

Number of Supporting Documents[60]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	1	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible[61]	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

[60] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[61] Proposed criteria for high density based on expert opinion.

Ligurian-Corsican-Provençal Basin and Western Pelagos Sanctuary

Potential Criterion:	2B: Foraging Area
Species of Concern:	Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: Location inferred from Azzellino et al. (2008) and G. Notobartolo di Sciara recommendations	NMFS provided new kml for boundaries. *This area is within a nationally-designated marine mammal sanctuary*.
Proposed Seasonal Consideration:	July through August

Background

- The total size of the fin whale population in the Mediterranean is unknown. However, one study estimates that approximately 3,500 individuals range in a portion of the western basin. High whale densities, comparable to those found in rich oceanic habitats, were found in well-defined areas of high productivity. Most whales concentrate in the Ligurian-Corsican-Provençal Basin; however, neither their movement patterns throughout the region nor their seasonal cycle are clear (Notarbartolo-Di-Sciara, Zanardelli, Jahoda, Panigada, & Airoldi, 2003).
- During the summer months, the species is known to concentrate in high numbers in the Corso-Ligurian Basin, described as one of the principal feeding grounds for fin whales in the Mediterranean Sea (Notarbartolo-Di-Sciara, et al., 2003)
- One nine-year study surveyed a total of 73,046 km and reported 540 sightings of fin whales in the Ligurian Sea. Water depth was the most significant variable in describing fin whale distribution, with more than 90% of sightings occurring in waters deeper than 2,000m (S Panigada et al., 2005).
- One study sought to correlate marine mammal presence in the Ligurian Sea with physical and biological parameters collected during NATO's SACLANT Undersea Research Centre's sea trials, called Sirena. The data suggested that large (sperm and fin) whales were predominately found in the deeper portion of the basin (D' Amico et al., 2003).
- In the western Ligurian Sea, many submarine canyons at the boundary between neritic and oceanic domains create the conditions for the accumulation of migratory micronektonic species in the continental slope waters. One study suggests that the periodic pattern of concentration of pelagic zooplankton near the bottom above the slope may provide an abundant food source for organisms living in the slope area, and it could also be the reason for the occasional presence of fin whales over the upper slope (Azzellino, Gaspari, Airoldi, & Nani, 2008)
- Most of the fin whale sightings occurred along the 2,000-m depth contour. Also, Fin whales showed also a periodic east-to west pattern in their movements during the July–August period. Such a pattern suggests once more a relationship with the counter-clockwise circulation of the Liguro-Provenc- al-Catalan Current (Azzellino, et al., 2008).
- Azzellino et al. (2008) noted that bottlenose dolphin, Risso's dolphin, sperm whale and Cuvier's beaked whale were all found associated with well-defined depth and slope gradients showing very clear preferences for specific physical habitats, respectively, the shelf-edge, the upper slope and the lower slope.

Number of Supporting Documents[62]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	3 - Eligible	3 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

[62] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

IUCN Marine Region 4: Northwest Atlantic Ocean

Harbor Porpoise Take Reduction Management Areas (United States)

Potential Criteria:	2A: High Density 2B: Migration Route 2B: Foraging Area
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration: *Basis: U.S. Government These areas are designated in the Harbor porpoise take reduction plan* (75 FR 7402; 19 February 2010).	See management area tables below.

MID-COAST MANAGEMENT AREA

Point	N. lat.	W. long.
MC1	42°30.0′	70°50.1′ (MA shoreline).
MC2	42°30.0′	70°15.0′
MC3	42°40.0′	70°15.0′
MC4	42°40.0′	70°00.0′
MC5	43°00.0′	70°00.0′
MC6	43°00.0′	69°30.0′
MC7	43°30.0′	69°30.0′
MC8	43°30.0′	69°00.0′
MC9	44°17.8′	69°00.0′ (ME shoreline).

STELLWAGEN BANK MANAGEMENT AREA

Point	N. lat.	W. long.
SB1	42°30.0′	70°30.0′
SB2	42°30.0′	70°15.0′
SB3	42°15.0′	70°15.0′
SB4	42°15.0′	70°30.0′
SB1	42°30.0′	70°30.0′

SOUTHERN NEW ENGLAND MANAGEMENT AREA

Point	N. lat.	W. long.
SNE1	Western boundary as specified[1]	
SNE2	40°00.0′	72°30.0′
SNE3	40°00.0′	69°30.0′
SNE4	42°15.0′	69°30.0′
SNE5	42°15.0′	70°00.0′
SNE6	41°58.3′	70°00.0′ (MA shoreline).

[1] Bounded on the west by a line running from the Rhode Island shoreline at 41°18.2′ N. lat. and 71°51.5′ W. long. (Watch Hill, RI), southwesterly through Fishers Island, NY, to Race Point, Fishers Island, NY; and from Race Point, Fishers Island, NY; southeasterly to the intersection of the 3-nautical mile line east of Montauk Point; southwesterly along the 3-nautical mile line to the intersection of 72°30.0′ W. long.

OFFSHORE MANAGEMENT AREA

Point	N. lat.	W. long.
OFS1	42°50.0′	69°30.0′

OFFSHORE MANAGEMENT AREA—Continued

Point	N. lat.	W. long.
OFS2	43°10.0′	69°10.0′
OFS3	43°10.0′	67°40.0′
OFS4	43°05.8′	67°40.0′ (EEZ boundary).
OFS5	42°53.1′	67°44.5′ (EEZ boundary).
OFS6	42°47.3′	67°40.0′ (EEZ boundary).
OFS7	42°10.0′	67°40.0′
OFS8	42°10.0′	69°30.0′
OFS1	42°50.0′	69°30.0′

MUDHOLE NORTH MANAGEMENT AREA

Point	N. lat.	W. long.
MN1	40°28.1′	74°00.0′ (NJ shoreline).
MN2	40°30.0′	74°00.0′
MN3	40°30.0′	73°20.0′
MN4	40°05.0′	73°20.0′
MN5	40°05.0′	74°02.0′ (NJ shoreline).

MUDHOLE SOUTH MANAGEMENT AREA

Point	N. lat.	W. long.
MS1	40°05.0′	73°31.0′
MS2	40°05.0′	73°00.0′

MUDHOLE SOUTH MANAGEMENT AREA—Continued

Point	N. lat.	W. long.
MS3	39°51.0′	73°00.0′
MS4	39°51.0′	73°31.0′
MS1	40°05.0′	73°31.0′

Proposed Temporal Consideration:	Regions outside of 12-nmi from the coast within the following areas: Mid-Coast Management Area: September 15 through May 31 Stellwagen Bank Management Area: November 1 through May 31 Southern New England Management Area: December 1 through May 31 Offshore Management Area: November 1 through May 31 Mudhole North: January 1 through April 30 Mudhole South: January 1 through April 30

Background Provided by SME

- The Gulf of Maine/Bay of Fundy harbor porpoise (*Phocoena phocoena*) stock annually migrate through U.S. Atlantic waters from North Carolina in the winter to the Gulf of Maine and Bay of Fundy in the summer (Palka, Read, Westgate, & Johnston, 1996). They are in the northern Gulf of Maine and lower Bay of Fundy, Canada region during July and begin to migrate out during September. During September to December and April to June, they are seen in the lower Gulf of Maine and off the Atlantic coast of Nova Scotia near Halifax, although not in the numbers observed in the Bay of Fundy. During December to March, some of the population is presumed to be offshore of the US mid-Atlantic, from North Carolina to Massachusetts, as indicated by beach strandings (Haley & Read, 1993) and several sighting surveys (Northridge, 1996; Palka, 1995; Read, 1999; Winn, 1982). Although a few strandings have been found in Florida, the typical southerly boundary is Cape Hatteras, North Carolina (Palka, et al., 1996).
- The Gulf of Maine/Bay of Fundy harbor porpoise stock is considered a strategic stock because human-related mortalities exceed the potential biological removal (PBR) level (Waring, Josephson, Fairfield-Walsh, & Maze-Foley, 2009).
- Harbor porpoises are small sized, so they are unable to carry large energy stores (Koopman, 1998). Thus, their patterns of movement are likely to be strongly related to the distribution of their prey (Johnston, Westgate, & Read, 2005). Their primary prey are juvenile Atlantic herring *Clupea harengus harengus* though they also feed on silver hake *Merluccius bilinearis*, hake *Urophycis* spp. and pearlsides *Maurolicus weitzmani* (Gannon, Craddock, & Read, 1998).
- Because during the harbor porpoise's annual migrations they have consistently been found to inhabit certain regions in high to intermediate density levels where their prey are commonly found and where gillnet fishing commonly occurs, management actions have been developed to reduce the bycatch of harbor porpoises during specific times in specific management areas (75 FR 7383-7402; 19 February 2010). These times and areas (detailed above in the Proposed Temporal Consideration section) are clearly important habitat for this species and should receive appropriate protection. Management actions include restricting gillnet fishing or require gillnets to use pingers.

Number of Supporting Documents[63]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	3	1	0	0	4	0

[63] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	3 - Eligible	0 - Not Applicable
Foraging Area	3 - Eligible	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	3 - Eligible	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed .

Cape Hatteras Special Research Area (United States)

Potential Criterion:	2A: High Density 2B: Foraging Area
Species of Concern:	Pilot whale spp. (*Globicephala* spp.)
Proposed Boundary Consideration:	An area bounded by the following coordinates: 75 º W 36º 25'N ;74 º W 36º 25'N 74 º W 35 º N; 75 º W 35 º N
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- Mixing of shelf, slope and Gulf Stream water over the continental shelf edge of the Middle Atlantic Bight near Cape Hatteras, North Carolina results in upwelling and Gulf Stream meanders (Churchill, Levine, Connors, & Cornillon, 1993)
- (Böhm, Hopkins, Pietrafesa, & Churchill, 2006; Churchill, et al., 1993). This creates a highly productive region which allows temperate and tropical marine species to flourish; species ranging from larval fish (Hare et al., 2002) to cetaceans (DON, 2007b; Garrison et al., 2003; Waring, et al., 2009).
- The Cape Hatteras Special Research Area, an area off Cape Hatteras within the above productive region, has a high density of pilot whales and high bycatch rates of pilot whales in the pelagic long line fishery (74 FR 23349-23358; May 19, 2009).
- Inside this Research Area, pelagic long line fishers are required to carry an observer on board, if requested, and to participate in focused research on pilot whale interactions with the pelagic longline fishery.
- Sightings of pilot whales (*Globicephala sp*.) in the western North Atlantic occur primarily near the continental shelf break ranging from Florida to the Nova Scotian Shelf (Mullin & Fulling, 2003). The long-finned pilot whale (*Globicephala melaena*) is distributed from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea (Abend, 1993; Abend & Smith, 1999; Buckland, Anderson, Burnham, & Laake, 1993; Leatherwood, Caldwell, Winn, Schevill, & Caldwell, 1976; Sergeant, 1962). Long-finned pilot whales and short-finned pilot whales (*Globicephala macrorhynchus*) overlap spatially along the mid-Atlantic shelf break between Cape Hatteras, North Carolina and New Jersey (Garrison, Martinez, & Maze-Foley, (in review); Payne & Heinemann, 1993). In addition, short-finned pilot whales are documented along the continental shelf and continental slope in the northern Gulf of Mexico (Hansen, Mullin, Jefferson, & Scott, 1996; Mullin & Fulling, 2003; Mullin & Hoggard, 2000), and they have also been seen in the wider Caribbean.
- Pilot whales are bycaught in the U.S. Atlantic pelagic longline, mid-Atlantic midwater trawl and the mid-Atlantic bottom trawl fisheries (Waring, et al., 2009).

Number of Supporting Documents[64]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
6	1	0	0	1	6	0

[64] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	3 - Eligible	0 - Not Applicable
Foraging Area	3 - Eligible	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

Georges Bank (United States)

Potential Criterion:	2A: High Density 2B: Foraging Area 2B: Migration Route
Species of Concern:	North Atlantic Right whale (*Eubalaena glacialis*); Beaked whales (*Mesoplodon spp*. and *Ziphius spp*.); Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration:	An area bounded by the following coordinates: 40º 00' N, 72º 30' W 39º 20' N, 71º 54' W 39º 30' N, 71º 25' W 39º 45' N, 69º 00' W 40º 26' N, 66º 43' W 41º 45' N, 65º 26' W 42º 20' N, 66º 06' W 42º 18' N, 67º 23' W *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically designated area of biological importance.*
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- Georges Bank is a region very rich with marine life, ranging from plankton to marine mammals (Link et al., 2008; Steele et al., 2007) and is among the most diverse, productive, and trophically complex marine temperate areas in the world (Link, et al., 2008; Overholtz & Link, 2007).
- The northern edge of Georges Bank is a relative shallow, cool region where the Georges Bank anti-cyclonic frontal circulation system deposits abundant amounts of copepods, such as *Calanus* (Durbin et al., 2003). As a result of this abundant food, the northern edge of Georges Bank is a foraging area for many cetaceans including endangered whales, such as right whales (*Eubalaena glacialis*), humpback whales (*Megaptera novaeangliae*), sei whales (*Balaenoptera borealis*), and fin whales (*Balaenoptera physalus*), and a variety of small cetaceans, such as pilot whales (*Globicephala spp.*), white-sided dolphins (*Lagenorhynchus acutus*), common dolphins (*Delphinus delphis*), and Risso's dolphins (*Grampus griseus*) (DON, 2007a; Pace & Merrick, 2008; Palka, 2006; Rossman, 2009; Selzer & Payne, 1988; Vigness-Raposa, Kenney, Gonzalez, & August, 2009; Waring, et al., 2009; Winn, 1982)
- The southern edge of Georges Bank is a different habitat with its warmer shelf-slope front, many deep canyons (e.g. Hydrographer and Oceanographer canyons), warm intrusions of the Gulf Stream, and steep shelf edge (Mooers et al. 1979). This habitat also has high densities of cetaceans, though some of the species are different from the northern edge of Georges Bank. Species commonly found foraging on the southern edge of Georges Bank include beaked whales (Mesoplodon spp. and Ziphius spp.), fin whales, sperm whales (*Physeter macrocephalus*), pilot whales, spotted dolphins (*Stenella attenuata*), striped dolphins (*Stenella coeruleoalba*), offshore bottlenose dolphins (*Tursiops truncatus*), Risso's dolphins, and common dolphins (DON, 2007a, 2007b; Hamazaki, 2002; Palka, 2006; Selzer & Payne, 1988; Waring, et al., 2009).
- In addition, the cetacean density is even larger because some species migrate through Georges Bank and do not reside for long time periods on George Bank. Examples of these species are harbor

porpoises (*Phocoena phocoena*), minke whales (*Balaenoptera acutorostrata*), and killer whales (*Orcinus orca*) (Hamazaki, 2002; Palka, Orphanides, & Warden, 2009).

- The species composition in the northern and southern edges of Georges Bank differs from season to season; however, in total there are high densities of foraging cetaceans during all parts of the year, where the winter has the lowest densities (DON, 2007a; Winn, 1982).

Number of Supporting Documents[65]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	0	0	0	0	8	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	3 – Eligible	3 – Eligible
Foraging Area	4 – Eligible	4 – Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	4 – Eligible	4 – Eligible
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

[65] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Challenger Bank (Bermuda)

Potential Criteria:	2B: Migration Route 2B: Foraging Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration: Location inferred from Stone et al. (1987)	Challenger Seamount 32° 7.708'N, 65° 4.888'W to 32° 5.661'N, 65° 7.881'W to 32° 2.151'N, 65° 6.009'W to 32° 1.064'N, 65° 2.303'W to 32° 2.557'N, 64° 59.360'W to 32° 5.051'N, 65° 1.071'W to 32° 5.812'N, 65° 1.675'W *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	March and April

Background

- Historical accounts show that humpback whales have frequented Bermuda waters, which are located half-way between wintering and summering grounds in the western North Atlantic, since the early 17th century (Stone, Katona, & Tucker, 1987). Stone et al. (1987) suggested that humpback whales from the North Atlantic feed briefly and opportunistically at Bermuda (32°20'N) while migrating (Danilewicz, Tavares, Moreno, Ott, & Trigo, 2009).
- Humpback whales were common in Bermudian coastal waters during the late winter and spring (March-May); sperm whales, in offshore waters probably throughout much of the year (Reeves, Mckenzie, & Smith, 2006)
- Humpbacks utilize Bermuda as a mid-ocean habitat through which all members of the western North Atlantic population migrate during spring (Stone, et al., 1987).
- Humpbacks returning to their northern feeding grounds may take more westerly routes that in many cases pass close to Bermuda where as suggested by Stone et al. (1987), they may linger and feed (Clapham & Mattila, 1990).
- Stone et al. (1987) suggest that the presence of humpbacks at Bermuda, a way-point during the springtime northward migration, may be attributed to increased food availability, providing the first opportunity to feed after the wintering ground fast (Baraff, Clapham, Mattila, & Bowman, 1991).
- There is also evidence suggesting that humpback whales feed at Bermuda on deep water scattering layers during their stop-over (Stone, et al., 1987).
- It seems likely that humpbacks returning to their northern feeding grounds may take more westerly routes that in many cases pass close to Bermuda where, as suggested by Stone et al. (1987), they may linger and feed (Clapham & Mattila, 1990).
- The Humpback Whale Research Project, Bermuda states that the humpbacks migrate past Bermuda starting late February until mid-May. Humpback whales are located on the Sally Tucker (N 32°10.8170' W 064°59.4890') and Challenger seamounts some two to fifteen miles offshore. http://www.whalesbermuda.com/index.php?option=com_content&view=section&layout=blog&id=7&Itemid=59

Number of Supporting Documents[66]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
5	0	0	1	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	2 – Eligible	2 – Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	2 –Eligible	2 –Eligible
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

[66] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Roseway Basin Right Whale Conservation Area (Canada)

Potential Criterion:	2B: Foraging Grounds
Species of Concern:	North Atlantic right whale (*Eubalena glacialis*)
Proposed Boundary Consideration: Basis: *Canadian Govt.*	An area bounded by the following coordinates: NW 43° 05'N, 65° 40'W NE 43° 05'N, 65° 03'W SW 42° 45'N, 65° 40'W SE 42° 45'N, 65° 03'W
Proposed Seasonal Consideration:	*Canadian Restriction is June through December.*

Background

- In 2008, Transport Canada implemented the Roseway Basin Area to be Avoided (ATBA) following its adoption by the International Maritime Organization (IMO). The measure is seasonal and recommended for all vessels ≥ 300 gross tonnage from June through December. The aim of this ATBA is to protect the endangered North Atlantic right whale from ship strikes and to enhance maritime safety (IMO, 2007).
- From 1999 to 2001, Baumgartner et al. (2003) conducted surveys in Roseway Basin to investigate the physical and biological oceanographic factors associated with North Atlantic right whale occurrence. They noted that right whales in these regions fed on *Calanus finmarchicus*.
- Spatial variability in right whale occurrence was associated with water depth and the depth of the bottom mixed layer. *C. finmarchicus* CS aggregated over the deepest water depths in both regions, and within these areas, right whales occurred where the bottom mixed layer forced discrete layers of *C. finmarchicus* to occur shallower in the water column (allowing more efficient foraging) (Baumgartner, et al., 2003).
- Baumgartner et al. (2003) concluded that annual increases in right whale occurrence appeared to be associated with decreases in sea surface temperature (SST) in both regions; however, they any further observation merits based on the short duration of the three-year study.
- Baumgartner et al. (2003) concluded that spatial variability in right whale occurrence was associated with water depth and the depth of the bottom mixed layer, within the Bay of Fundy and Roseway Basins. Copepods (*Calanus finmarchicus*) aggregated over the deepest water depths in these areas. Within these areas, right whales occurred where the bottom mixed layer forced discrete layers of *C. finmarchicus* to occur shallower in the water column, which allows more efficient foraging.
- The spatial and interannual variability in occurrences observed for right whales might be associated with the SST gradient, a proxy for ocean fronts (Baumgartner, et al., 2003).
- The summer feeding areas are in waters near Nova Scotia and the principal spring feeding ground (April-June) is in the GSC (Kenney & Wishner, 1995).

Number of Supporting Documents[67]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	1	0

[67] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	4 – Eligible	4 – Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

Great South Channel (United States)

Potential Criteria:	2B: Critical Habitat 2B: Foraging Area
Species of Concern:	North Atlantic right whale (*Eubalena glacialis*)
Proposed Boundary Consideration: Basis: U.S. Government.	It is bounded by the following coordinates: 42°30′00.0″ N, 069°45′00.0″ W 41°40′00.0″ N, 069°45′00.0″ W 41°00′00.0″ N, 069°05′00.0″ W 42°09′00.0″ N, 067°08′24.0″ W 42°30′00.0″ N, 067°27′00.0″ W 42°30′00.0″ N, 069°45′00.0″ W *This area is within designated critical habitat.*
Proposed Seasonal Consideration:	*Ship Strike Rule is April 1 to July 31.*

Background

- The Great South Channel (GSC) area lies east of Cape Cod, Massachusetts, U.S.A. between Nantucket Shoals on the west and Georges Bank on the east. Right whales are the world's most endangered large whale species, and the GSC is the principal feeding ground of the western North Atlantic population (Kenney & Wishner, 1995).
- The South Channel Ocean Productivity Experiment (SCOPEX), a multidisciplinary study of a whale-zooplankton predator-prey system in the southwestern Gulf of Maine, confirmed the co-occurrence of right whales with high density *Calanus finmarchicus* patches. Also, the whales fed on patches with higher proportions of larger lifestages of *C. finmarchius* (Kenney & Wishner, 1995).
- The summer feeding areas are in waters near Nova Scotia and the principal spring feeding ground (April-June) is in the GSC (Kenney & Wishner, 1995).
- Right whales were only rarely observed in the GSC during the fall and winter seasons. Most sightings occurred in April, May, and June, with a large peak in sighting frequency in May (Kenney, Winn, & Macaulay, 1995).
- In the Great South Channel Seasonal Management Area, NOAA has proposed an April through July requirement that all vessels over 300 gross tons travel no faster than 10 knots. To physically separate whales and vessels, NOAA has also considered designating the Great South Channel critical habitat area as an International Maritime Organization-approved Area To Be Avoided (ATBA). NMFS proposed seasonal restriction of the April through July based on the number of greatest sighting densities found in the southwest corner of the GSC Critical Habitat (Merrick & Cole, 2007).
- NMFS designated this area as critical habitat and an important feeding area for the North Atlantic right whale in 1994 (NMFS, 1994).

Number of Supporting Documents[68]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	1	0

[68] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	3 – Eligible	3 – Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	4 – Eligible	4 – Eligible
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

The Gully Marine Protected Area (Canada)

Potential Criteria:	2A: High Density 2B: Foraging Grounds
Species of Concern:	Northern bottlenose whales (*Hyperoodon ampullatus*)
Proposed Boundary Consideration: Basis: Canadian Government	An area bounded by the following coordinates: 44°13′ N, 59°06′ W to 43°47′ N, 58°35′W; 43°35′ N, 58°35′ W to 43°35′ N, 59°08′ W to 44°06′ N, 59°20′ W
Proposed Seasonal Consideration:	Year Round

Background

- The Gully, a submarine canyon off eastern Canada, was nominated as a pilot Marine Protected Area (MPA) in 1998, largely to safeguard the vulnerable population of northern bottlenose whales (Hooker, Whitehead, & Gowans, 2002).
- Northern bottlenose whales are consistently found through the year in the Gully (Whitehead, Gowans, Faucher, & McCarrey, 1997).
- A small, apparently isolated, and endangered population of approximately 130 northern bottlenose whales is found on the Scotian Slope south of Nova Scotia, Canada (Wimmer & Whitehead, 2004).
- A ship survey along the 1,000 m depth contour in 2001 showed northern bottlenose whales only in the Gully, Shortland Canyon, and Haldimand Canyon. Studies in 2002 reconfirmed the presence of the whales in the other canyons, although densities were about 50% lower than in the Gully (Wimmer & Whitehead, 2004)
- Hooker et al. (2002) estimated the energy consumption of bottlenose whales in The Gully and suggested that there must be a substantial spatial subsidy in the underlying food web of the submarine canyon to support the bottlenose whales using the Gully. Studies of this species' diet elsewhere in the North Atlantic Ocean have suggested specialization on the deep-sea squid, Gonatus fabricii (Hooker, Iverson, Ostrom, & Smith, 2001).

Number of Supporting Documents[69]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	4 – Eligible	0 - Not Applicable
Foraging Area	3 – Eligible	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[69] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

Shortland Canyon and Haldimand Canyon (Canada)

Potential Criteria:	2A: High Density 2B: Foraging Grounds
Species of Concern:	Northern bottlenose whales (*Hyperoodon ampullatus*)
Proposed Boundary Consideration: Location inferred from Wimmer and Whitehead (2004)	An area bounded by the following coordinates: 58°38'16.385"W, 44°11'56.984"N 57°54'5.541"W, 44°31'42.32"N 57°42'35.89"W, 44°8'43.019"N 58°29'39.147"W, 43°50'23.889"N
Proposed Seasonal Consideration:	Year Round

Background

- On the Scotian Shelf, northern bottlenose whales have been sighted most often in the deep waters of three underwater canyons (the Gully, Shortland Canyon, and Haldimand Canyon) along the shelf edge. They are thought to be year-round residents but winter distribution is not understood (DFO, 2007)
- The carrying capacity (the maximum number of individuals that a given environment can support) of northern bottlenose whales on the Scotian Shelf is unknown. The density of whales is higher in the Gully than in the other two canyons. This could indicate that there is room for population expansion in Shortland and Haldimand canyons. However a large canyon such as the Gully can have proportionately higher productivity due to its oceanographic and bathymetric (ocean depths) characteristics suggesting that it would be able to support higher densities of whales than smaller canyons (DFO, 2007).
- Haldimand and Shortland canyons are clearly important habitat for this species, and should receive appropriate protection. Research in 2002 confirmed that northern bottlenose whales regularly use Shortland and Haldimand canyons (Wimmer & Whitehead, 2004).
- Northern bottlenose whales were encountered in Shortland and Haldimand canyons at a rate about half that in The Gully, which suggests about half the density. Also, the whales seem to prefer waters between about 800 and 1500 m deep within all three canyons (Wimmer & Whitehead, 2004).
- Although there have been several sightings of northern bottlenose whales in other areas on and surrounding the Scotian Slope, the only areas in which we know they can be reliably found are the Gully and Shortland and Haldimand canyons (Wimmer & Whitehead, 2004) .
- Northern bottlenose whales do move between the three canyons. The function of this movement can be considered from the perspective of optimal foraging on dispersed patches of prey. As the Gully (the richer patch) fills with more northern bottlenose whales, individuals would likely do better in terms of individual net gain to use other, albeit poorer, areas with fewer competitors (Haldimand and Shortland canyons and other areas (Wimmer & Whitehead, 2004).

Number of Supporting Documents[70]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	1	0

[70] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	3 – Eligible	0 - Not Applicable
Foraging Area	3 – Eligible	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

IUCN Marine Region 5: Northeast Atlantic Ocean

Dogger Bank (OSPAR International)

Potential Criterion:	2A: High Density
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration:	None submitted.
Proposed Seasonal Consideration:	None submitted.

Background

- In 2002 and 2003, Germany's Federal Agency for Nature Conservation (BfN) conducted aerial surveys in the German EEZ and 12 nm zone to assess proposed Sites of Community Importance under the European Union (EU) Habitats Directive. The BfN found that the densities estimated for this site were fairly high, indicating an important area for porpoises. Also, Dogger Bank was the only area where sightings of other species could be observed (white-beaked dolphin and minke whale) (Gilles, Herr, Lehnert, Scheidat, & Siebert, 2008).
- Other studies (Siebert et al., 2006) have collected data on the occurrence of harbour porpoises in German waters from 1988 to 2002 from dedicated aerial surveys, incidental sightings and strandings. In the article, Siebert et al. notes that aerial surveys conducted in 1995 and 1996 revealed a mean abundance of 4288 (in 1995) and 7356 harbour porpoises (in 1996) in the German North Sea study area. Further, they describe reports of 791 incidental sightings of harbour porpoise pods in German and partly Danish coastal waters of the North and Baltic Seas from 1988 to 2002.
- Siebert et al. (2006) also found that 996 harbour porpoise strandings along the German North Sea coast in the period 1990 to 2001. Only 17 animals were identified as by-catch.
- Siebert et al. (2006) noted that their observational data demonstrated a strong seasonality of harbour porpoise occurrence off the German coast with highest numbers during the summer months.

Number of Supporting Documents[71]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[71] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Sylt Outer Reef (Germany)

Potential Criteria:	2A: High Density 2B: Calving Grounds
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration:	None submitted.
Proposed Seasonal Consideration:	None submitted.

Background

- In 2002 and 2003, Germany's Federal Agency for Nature Conservation (BfN) conducted aerial surveys in the German EEZ and 12 nm zone to assess proposed Sites of Community Importance under the European Union (EU) Habitats Directive. The BfN found that the densities estimated for this site were fairly high, indicating an important area for porpoises.
- Giles et al. (2008) noted that the highest density was estimated for Sylt Outer Reef (2002: 2.7 individuals/km^2; 2003: 3.7 individuals/km^2).
- Important habitats for harbour porpoises were detected west of the islands of Sylt and Amrum in the North Sea and around the Schlei estuary, in waters west of Fehmarn and the Fischland-Darss area in the Baltic Sea (Siebert, et al., 2006).
- In the BfN evaluation of sites in the North Sea, only the Sylt Outer Reef was delineated for porpoises using the criteria of Article 4.1 Habitats Directive. There, three selection criteria were positively validated: (1) continuous or regular presence, (2) good population density, and (3) a high ratio of mother-calf pairs (60%) (Gilles, et al., 2008).

Number of Supporting Documents[72]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	3 - Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

[72] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

IUCN Marine Region 6: Baltic Sea

Pommeranian Bay, Adler Ground, and Western Ronne Bank (Germany)

Potential Criterion:	2B: Breeding Area
Species of Concern:	Harbor porpoise (*Phocoena phocoena*)
Proposed Boundary Consideration:	None submitted.
Proposed Seasonal Consideration:	Spring – Fall

Background

- The harbor porpoise is the only resident cetacean species in the German Baltic Sea (Scheidat, Gilles, Kock, & Siebert, 2008).
- One study (Verfuß et al., 2007) indicated regular presence of harbor porpoises within the Baltic Sea and noted that the porpoise usage patterns of the area indicated geographical and seasonal variation.
- The larger numbers of harbor porpoise detections in spring to autumn compared with winter suggests that the German Baltic Sea is an important breeding and mating area for these animals (Verfuß, et al., 2007).
- A recent Danish effort (http://www2.dmu.dk/Pub/FR657.pdf) to designate and identify areas of high harbor porpoise density has collected all relevant data on movements and density of the harbor porpoises in Danish and adjacent waters.

Number of Supporting Documents[73]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	2 - Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

[73] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

IUCN Marine Region 7: Caribbean

Continental Slope of the Northern Gulf of Mexico (United States)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Critical Habitat
Species of Concern:	Sperm whale, several cetacean species
Proposed Boundary Consideration: *Basis: T. Jefferson*	Between 200 and 1,000 meter depth contours. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited (Sparks, 1997) and (O'Hern & Biggs, 2009) for support.

Number of Supporting Documents[74]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible[75]	0 - Not Applicable
Foraging Area	1 - Not Eligible[76]	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

[74] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[75] Proposed criteria for high density based on expert opinion.
[76] Proposed criteria for foraging based on expert opinion.

Southeastern U.S. Right Whale Seasonal Habitat (United States)

Potential Criteria:	2B: Calving Area 2B: Designated Critical Habitat
Species of Concern:	North Atlantic right whale (*Eubalena glacialis*)
Proposed Boundary Consideration: Basis: U.S. Government	The coastal waters between 31°15' N and 30°15' N from the coast out 15 nautical miles; and the coastal waters between 30°15' N and 28°00' N from the coast out 5 nautical miles. *This area is within designated critical habitat.*
Proposed Seasonal Consideration:	November through March

Background

- NMFS has designated critical habitat for the NARW in coastal waters of the southeastern United States (SEUS) (NMFS, 1994). This area is the only known calving ground for NARW off the SEUS in the winter (Kraus, Hamilton, Kenney, Knowlton, & Slay, 2001).
- The NARW calving season extends from late November through early March with an observed peak in January. The presence of females with calves was primarily limited to the coastal waters between 27°30'N and 32°00'N latitudes (NMFS, 1994).
- Based on the number of calves and females with calves in the SEUS since 1980, NMFS considers the SEUS as the primary calving area for the population (NMFS, 1994).
- Keller et al. (2006) found that SST likely plays an important role in the distribution of right whales in the southeastern, winter habitat. Warm Gulf Stream waters, generally found south and east of delineated critical habitat, represent a thermal limit for right whales and play an important role in their distribution within the calving grounds (Keller et al., 2006).

Number of Supporting Documents[77]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	4 - Eligible	4 – Eligible
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	4 - Eligible	4 – Eligible
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

[77] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Silver Bank and Navidad Bank (Dominican Republic)

Potential Criteria:	2B: Breeding Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration:	Silver Bank: 20° 38.899'N, 69° 23.640'W to 20° 55.706'N, 69° 57.984'W to 20° 25.221'N, 70° 0.387'W to 20° 12.833'N, 69° 40.604'W to 20° 13.918'N, 69° 31.518'W to 20° 28.680'N, 69° 31.900'W Navidad Bank: 20° 15.596'N, 68° 47.967'W to 20° 11.971'N, 68° 54.810'W to 19° 52.514'N, 69° 0.443'W to 19° 54.957'N, 68° 51.430'W to 19° 51.513'N, 68° 41.399'W *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	December through April

Background

- One survey conducted between 14 February and 19 March 1984 reported 317 whales were individually identified from photographs of ventral fluke patterns. Analysis of matches suggests that whales from the various high-latitude feeding stocks mix randomly on Silver Bank. Overall, the number of whales, calves, and surface-active groups observed during this study confirms the apparently singular importance of Silver Bank to the breeding ecology of western North Atlantic humpback whales (Mattila, Clapham, Katona, & Stone, 1989).
- Fast moving groups containing three or more adult humpback whales are found in the winter on Silver Bank in the West Indies. Many of these groups (Mattila, et al., 1989) have a definite structure: a central Nuclear Animal, with or without a calf, is surrounded by escorts who compete, sometimes violently, for proximity to the Nuclear Animal (Tyack & Whitehead, 1982).
- The humpback whales which winter in the West Indies are principally found over banks which are at latitudes between 10° and 22° N, have substantial areas of flat bottom between 15 and 60 m deep, and lie less than 30 km from the North Atlantic 2000-m contour. The surface sea temperatures in these areas are between 24 and 28° C (Whitehead & Moore, 1982).
- The major concentrations of the humpbacks, which feed little in winter, are on Silver and Navidad banks. On Silver Bank the humpback and humpback song densities peak in the centre of the Bank. Mothers with calves are generally found in areas of calm water, and singers are found over areas with a flat bottom, where they meander slowly (Whitehead & Moore, 1982).
- In 1992, researchers with the large-scale project known as Years of the North Atlantic Humpback (YONAH), obtained several hundred biopsies from humpback whales on Silver Bank, a limestone platform reef off the Dominican Republic's northern coast. Silver Bank represents the most important mating and calving area for North Atlantic humpbacks (Balcomb and Nichols 1982, Mattila et al. 1989), with as many as two or three thousand individuals present during the peak of the season (Clapham & Mattila, 1993).

Number of Supporting Documents[78]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	4 - Eligible	4 – Eligible
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

[78] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

IUCN Marine Region 8: West Africa

Canary Islands Cetacean Marine Sanctuary (Canary Islands)

Potential Criteria:	2A: High Density 2B: Critical Habitat
Species of Concern:	Short-finned Pilot Whale (*Globicephala macrorhynchus*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	*This area is a proposed nationally-designated marine mammal sanctuary.* The proposed boundary for the sanctuary could encompass: either all or portion of national waters to the limit of the EEZ of the Canary Islands, or possibly the waters between the islands, with or without the main whale watch areas off southwest Tenerife and La Gomera. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The Canary Islands represent a major area of concentration for the short-finned pilot whale (*Globicephala macrorhynchus*).
- This population is resident and is under significant stress from ship strikes and poorly-regulated whale-watching activities (Heimlich-Boran, 1993).

Number of Supporting Documents[79]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible[80]	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable[81]	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

[79] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[80] Proposed criteria for high density based on expert opinion.
[81] Area does not qualify as critical habitat as defined in the NMFS classification schema.

Tristan da Cunha Cetacean Sanctuary (British Overseas Territory)

Potential Criteria:	2A: High Density 2B: Critical Habitat
Species of Concern:	Tasman beaked whale (*Tasmacetus shepherdi*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	*This area is a nationally-designated marine mammal sanctuary.* SME did not submit a spatial file.
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- This subantarctic island has recently been found to contain a relatively high concentration of Shepherd's beaked whale (*Tasmactus shepherdi*), a beaked whale species that is considered rare and presumably highly-susceptible to impacts from naval sonar (Best, Glass, Ryan, & Dalebout, 2009).

Number of Supporting Documents[82]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible[83]	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable[84]	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
0	SME did not provide boundary information.

[82] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[83] Proposed criteria for high density based on expert opinion.
[84] Area does not qualify as critical habitat as defined in the NMFS classification schema.

Coastal Waters of Gabon, Congo and Equatorial Guinea (West Africa)

Potential Criteria:	2A: High Density (*TJ*, *HR*) 2B: Breeding / Calving (*TJ*, *HR*) 2B: Foraging Grounds (*HR*) 2B: Migratory Route (*HR*) 2B: Critical Habitat (*TJ*, *HR*) 2C: Small, Distinct Population (*HR*)
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) (*TJ*, *HR*); Blue Whale (*Balaenoptera musculus*) (*HR*); Sperm Whale (*Physeter macrocephalus*) (*HR*); Beaked Whales (Ziphiidae) (*HR*); Bottlenose Dolphins (*Tursiops truncates*) (*HR*); Atlantic Humpback Dolphins (*Sousa teuszii*) (*HR*); Melon-headed Whales (*Peponocephala electra*) (*HR*)
Proposed Boundary Consideration:	SME: Territorial sea to 20 nm offshore. (*TJ*); Coasts of Gabon, Congo and Equatorial Guinea to 40 nm. (*HR*). *Basis: T. Jefferson, H. Rosenbaum. Published literature, IWC reports and Wildlife Conservation Society unpublished data. NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.* NMFS boundary: An exclusion zone following the 500-m isobath extending from 3° 31.055'N, 9° 12.226'E in the north offshore of Malabo southward to 8° 57.470'S, 12° 55.873'E offshore of Luanda.
Proposed Temporal Consideration:	Year-round (*HR*)

Background Provided by SME

- Well documented breeding habitat and migratory corridor for humpback whales, with particularly good documentation of dense aggregations in coastal waters of Gabon, particularly areas around Port Gentil, and the coastal shelf north and south to Luanda and northwards to Bioko (Findlay, 2001; Rosenbaum & Collins, 2006; Townsend, 1935; Walsh, Fay, Gulick, & Sounguet, 2000) and (Collins et al., 2008; Rosenbaum et al., 2009; Strindberg, Ersts, Collins, Sounguet, & Rosenbaum, In Press).
- Documented presence of the rare and likely endangered Atlantic Humpback dolphin in coastal waters of Gabon and Congo. The global population is small, and their range heavily fragmented. Gabon and Congo may host the healthiest habitat and populations remaining (low hundreds). (Collins, Ngouessono, & Rosenbaum, 2004; Van Waerebeek et al., 2004).
- Presence of sperm whales and beaked whales (Best, 2007; Townsend, 1935; Weir, 2006b, 2007).
- High biodiversity documented in the Port Gentil region due to the convergence of habitat suitable for both inshore, shallow water, and offshore, deep water species (Rosenbaum & Collins, 2006; Weir, 2006a) Findlay et al. 2006; Best 2007).
- Blue whales recorded on multiple occasions in the inshore waters of Northern Angola during dedicated study in 2008 (WCS unpublished data). Whaling catch record also suggests blue whales form a typical component of the cetacean species assemblage of the area (Best, 2007; Branch et al., 2007).
- Humpback whales (*Megaptera novaeangliae*) use the waters offshore of Gabon as a major breeding area in the Southern Hemisphere winter. There is concern about the impacts of extensive oil exploration and extraction has on the population, which has been studied in detail for several years (Rosenbaum & Collins, 2006).

- Although their current status in waters of Congo and Equatorial Guinea are unknown, the coastal waters of Gabon are inhabited by an apparently small and localized population of Atlantic humpback dolphins (*Sousa teuszii*), which is listed by the IUCN as Vulnerable to extinction. Several sightings of these animals have been made there in recent years and preliminary evidence suggests that all populations of this species are small and fragmented (Collins, et al., 2004; Van Waerebeek, et al., 2004). In addition, these dolphins are highly vulnerable to impacts from oil exploration and extraction, which occurs along much of the West Africa coast.

Number of Supporting Documents[85]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
11	2	0	0	0	4	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible[86]	0 - Not Applicable
Foraging Area	1 - Not Eligible[87]	0 - Not Applicable
Breeding / Calving	4 - Eligible	4 – Eligible
Migration Route	4 - Eligible	4 – Eligible
Critical Habitat	0 - Not Applicable[88]	0 - Not Applicable
Small Distinct Population	2 – Eligible	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

[85] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[86] Proposed criteria for high density based on expert opinion.
[87] Proposed criteria for foraging based on expert opinion.
[88] Area does not qualify as critical habitat as defined in the NMFS classification schema.

IUCN Marine Region 9: South Atlantic Ocean

Buenos Aires Province Coastal Area (Argentina)

Potential Criterion:	2A: High Density 2B: Breeding / Calving 2B: Foraging Area 2C: Small, Distinct Population
Species of Concern:	Franciscana dolphin (*Pontoporia blainvillei*), Burmeister's Porpoise (*Phocoena spinipinnis*)
Proposed Boundary Consideration: *Location inferred from H. Rosenbaum*	The coastal waters of the Buenos Aires Province, from the coast out 10 nautical miles, between 35°00' S and 38°57' S. The coastal waters of the Buenos Aires Province, from the coast out 50 nautical miles, between 38°57'S and 40°37'S, to cover the island systems in the area. The coastal waters of the Buenos Aires Province, from the coast out 10 nautical miles, between 40°37' S and 42°00' S. *This area includes 12 nationally and/or internationally (UNESCO)-designated marine protected areas* (*MPAs*)
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- The Franciscana dolphin is endemic to the Southwestern Atlantic Ocean, from Northern Brazil to Northern Argentina, and has been recognized as the most endangered cetacean in the region (Bordino et al., 2002; Secchi, Danilewicz, & Ott, 2003).
- This species is listed as Vulnerable by the IUCN and in Appendix II of CITES. The Burmeister's porpoise is endemic to the coasts of South America, from Southern Brazil to Northern Peru. This species is listed as conservation dependent-Data Deficient by the IUCN and in Appendix II of CITES. The coastal area of the Buenos Aires represents the southern limit of the Franciscana dolphin distribution range, and approaches the northern distribution range limit of Burmeister's porpoises.
- Density estimations for Franciscanas in the Buenos Aires area range between 0.37 and 0.48 ind/km^2 in the Buenos Aires area, which translates to an estimated abundance of approximately 30,000 individuals for this area (Bordino, Albareda, & Fidalgo, 2004; Crespo, Pedraza, Grandi, Dans, & Garaffo, 2004; Crespo, Pedraza, Grandi, Dans, & Garaffo, 2010) .
- Recent genetic data shows clear evidence of population structure of Franciscanas in Argentina, within the Buenos Aires Area (Lázaro, Lessa, & Hamilton, 2004; Mendez, Rosenbaum, & Bordino, 2008). Specifically, Mendez and colleagues provided evidence of at least three distinct populations in this area: one in northern Buenos Aires in the Samborombón area, at least one in eastern Buenos Aires between 36°30' deg. S and 38°00' deg. S., and at least another isolated population in southern Buenos Aires between 38°00' deg. S. and the species' distribution limit at 42°00' deg. S. (Mendez, et al., 2008; Mendez, Rosenbaum, Yackulic, Subramaniam, & Bordino, 2010). This genetic evidence is strongly supported by satellite tracking data for the species in northern and southern Buenos Aires (Bordino & Wells, 2005; Bordino, Wells, & Stamper, 2008).
- Based on environmental data and studies of fish community structure and abundance (Lasta, 1995; Lasta & Acha, 1996), coupled with the genetic evidence of *Franciscana* population structure in

Buenos Aires, Mendez et al. (2008) suggested that northern Buenos Aires could be a feeding area and calving ground for these dolphins.

- Genetic evidence suggests the existence of at least three isolated populations of Burmeister's porpoises along their distribution range: one population in coastal Peru, a second one in southern Chile, and a third one in Southern Argentina (Rosa et al., 2005). Because the Argentinean samples were collected in the Tierra del Fuego Province, over 2000 km of linear coastal distance from Buenos Aires, it is likely that future studies including specimens in this area uncover further population structure in Argentina.
- The Buenos Aires coastal area includes the following designated MPAs: Bahía de Samborombón (RAMSAR), Bahía San Blas-Isla Gama (National), Caleta de los Loros (National), Campos del Tuyú (National), Complejo Islote Lobos (National), Costero del Sur (National) ,Parque Costero del Sur (UNESCO), Dunas Atlántico Sur Mar Chiquita (National), Islas Embudo, Bermeja y Trinidad (National), Mar Chiquito (UNESCO), Punta Bermeja (National), and Rincon de Ajo (National).

Number of Supporting Documents[89]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	3	0	0	1	0	1

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible	0 - Not Applicable
Foraging Area	2 - Eligible	0 - Not Applicable
Breeding / Calving	2 - Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	2 - Eligible	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance. .

[89] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Patagonian Shelf Break (Argentina)

Potential Criterion:	2B: Foraging Area
Species of Concern:	Southern elephant seal (*Mirounga leonina*)
Proposed Boundary Consideration: *Location inferred from Campagna et al. (1995, 1998, 1999, 2006) and Falabella et al. (2009). H. Rosenbaum*	Relevant areas are located between the isobaths of 200 and 2000 meters and the following latitudes: 1) 35°00'S and 39°00'S 2) 56°30'S and 58°30'S 3) 40°40'S and 42°30'S 2) 46°00'S and 48°50'S
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- The breeding aggregation of southern elephant seal at Peninsula Valdes is estimated to number some 50,000 individuals one year old or older. It is the only colony for the species that grew during about three decades and is today stable.
- Contrary to all other colonies of southern elephant seals, Peninsula Valdes is continental and is located in temperate waters rather than Antarctic of subantarctic waters (Campagna & Lewis, 1992).
- During foraging seasons (up to 7 month at sea), elephant seals combine exceptionally deep diving (up to 1500 m) with long-distance traveling, covering millions of square kilometers.
- The shelf break is an oceanic front exploited throughout the year by elephant seals. In summer (January – March) there is an intense use of the slope from the Rio de la Plata to the south of the San Jorge Gulf. In autumn, the main foraging areas are distributed to the south of the slope and around the Malvinas Islands (Falabella, Campagna, & Croxall, 2009).
- The shelf break front is a narrow transition region between subpolar and shelf waters that shows a moderate sea surface temperature front and chlorophyll-a maxima in summer resulting from upwelling created by the Malvinas Current interaction with the bottom topography (Romero, Piola, Charo, & Garcia, 2006; Saraceno, Provost, & Piola, 2005).
- During the foraging season, adults disperse widely, over millions of square kilometers. Females migrate longer distances than males, to the Argentine Basin. Males apparently prefer the edge of the continental shelf, which is much closer and more predictable in terms of productivity than the Basin. Juveniles behave as adults in terms of the extent of their migrations, although they show seasonal differences. While adults breed on land in the spring, juveniles are at sea, and while adult females are at sea after giving birth, juveniles molt on land see (Campagna, Fedak, & McConnell, 1999; Campagna, Le Boeuf, Blackwell, Crocker, & Quintana, 1995; Campagna et al., 2007; Campagna, Piola, Rosa Marin, Lewis, & Fernández, 2006; Campagna, Quintana, Le Boeuf, Blackwell, & Crocker, 1998; Campagna, Rivas, & Marin, 2000).

Number of Supporting Documents[90]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
9	0	0	0	0	1	0

[90] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	4 - Eligible	4 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed .

Southern Right Whale Seasonal Habitat (Argentina)

Potential Criteria:	2B: Calving Area 2B: Designated Critical Habitat
Species of Concern:	South Atlantic right whale (*Eubalena australis*)
Proposed Boundary Consideration: *Basis: H. Rosenbaum*	The coastal waters between 42°00'S and 43°00'S from the coast out 15 nautical miles including the enclosed bays of Golfo Nuevo, Golfo San Jose and San Matias *This area is contains designated calving habitat.*
Proposed Temporal Consideration:	May through December

Background Provided by SME

- The coastal waters surrounding Peninsula Valdes off the coast of Argentina contain one of the main calving areas for this species (Paine ref.).
- The southern right whale calving season extends from late May through late December with an observed peak in September. The presence of females with calves was primarily limited to the coastal waters between 42°00' S and 42°45'S latitudes (Paine et. Al, ref).
- Based on the number of females with calves in this area since 1970, this is considered one of the primary calving areas for the southern right whale population (Paine ref; Best ref).
- Although parts of Golfo Nuevo and all of Golfo San Jose have protected area status, southern right whales also range outside these bays throughout the season into Golfo San Matias and the Atlantic Ocean adjoining peninsula Valdes to 15nm from shore and further.

Number of Supporting Documents[91]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	4 - Eligible	4 - Eligible
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable[92]	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance. .

[91] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[92] Area does not qualify as critical habitat as defined in the NMFS classification schema.

IUCN Marine Region 10: Central Indian Ocean

Northern Bay of Bengal and Swatch-of-No-Ground (India)

Potential Criterion:	2A: High Density 2B: Breeding Calving 2B: Foraging Area 2C: Small, Distinct Population
Species of Concern:	Irrawaddy dolphin (*Orcaella brevirostris)* Finless porpoise (*Neophocaena phocaenoides)* Indo-Pacific humpback dolphin (*Sousa chinensis)* Indo-Pacific bottlenose dolphin (*Tursiops aduncus)* Bryde's whale (small form) (*Balaenoptera edeni)* Pantropical spotted dolphin (*Stenella attenuate)* Spinner dolphin (*S. longirostris)*
Proposed Boundary Consideration:	Area is inclusive of the Swatch-of-No-Ground Submarine Canyon and adjacent coastal waters, Bangladesh and northeastern India. SME Boundary: Polygon extending along the margins of the Sundarbans mangrove forest from a point in the east at 22º30'N, 91º40'E to a point in the west at 21º26'N, 87º41'E, following the Bangladesh coast south to 20º30'N, 92º30'E and to an offshore point at 20º30'N, 87º41'E, inclusive of the Swatch-of-No-Ground (SoNG) submarine canyon and St. Martin's Island. *Location inferred from Smith et al. (2008) and Mansur et al. (unpublished – MS submitted to Marine Mammal Science) in Bangladesh waters and inferred from similar habitat in Indian waters. This area lies adjacent to three UNESCO World Heritage sites in the Sundarbans and includes a proposed international Marine Protected Area for cetaceans in the SoNG (Bangladesh Cetacean Diversity Project, 2008).* NMFS' Suggested Boundary: Head of Song area inferred from Smith et al. (2008) for the area of Bryde's whale/calf sightings relative to depth contours in the Swatch-of-No-Ground of Bangladesh. 20° 59.735'N, 89° 7.675'E to 20° 55.494'N, 89° 9.484'E to 20° 52.883'N, 89° 12.704'E to 20° 55.275'N, 89° 18.133'E to 21° 4.558'N, 89° 25.294'E to 21° 12.655'N, 89° 25.354'E to 21° 13.279'N, 89° 16.833'E to 21° 6.347'N, 89° 15.011'E
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- The coastal and deep-sea waters of Bangladesh have recently been identified as a global 'hotspot' of cetacean abundance and diversity (Smith, Ahmed, Mowgli, & Strindberg, 2008).
- Coastal waters are influenced by discharge from the third-largest river system in the world, the Ganges/Brahmaputra/Meghna (GBM), which supplies about 133 x 10^9mol yr^{-1} to the Bay of Bengal that is more than 1.5% of the total riverine input to the world's oceans (Sarin, Krishnaswami, Dilli, Somayajulu, & Moore, 1989) and a seasonally reversing, wind-driven, basin-scale gyre (Somayajulu, Murty, & Sarma, 2003). These conditions combine to produce a highly stratified and productive sea-

surface layer that supports relatively large populations of Irrawaddy dolphins, finless porpoises, and Indo-Pacific humpback dolphins (Smith, et al., 2008). The first two species are Red Listed by the IUCN as 'vulnerable' and the third as 'near threatened.'

- A distance analysis of Irrawaddy dolphin and finless porpoise sightings made during a survey conducted in the winter season of 2004 resulted in abundance estimates of 5,383 (CV=39.5) and 1,382 (CV=54.8%) individuals, respectively (Smith, et al., 2008). This is the largest documented population of Irrawaddy dolphins by more than an order of magnitude. Its large size can almost certainly be explained by the extensive freshwater influence of the GBM system. The population estimate for finless porpoises also compares favorably to other marine areas where the species has been surveyed - e.g., Ariake Sound and Tachibana Bay (Yoshida, Shirakihara, Kishino, & Shirakihara, 1997) and Hong Kong and adjacent waters (Jefferson, Hung, Law, Torey, & Tregenza, 2002). Although an insufficient number of Indo-Pacific humpback dolphin groups were observed during the 2004 survey to estimate abundance (*n*=6), the relatively large size of some groups (>50 individuals) probably indicates a significant population.
- During the 2004 survey mentioned above all three species were found much farther offshore compared to other areas of their distribution (>30 nm for Irrawaddy dolphin, >36 nm for finless porpoise, and >19 nm for Indo-Pacific humpback dolphins) even though the survey was conducted in the winter when freshwater discharge was at its lowest. Habitat selection models for Irrawaddy dolphins indicate that the species would almost certainly be found even farther offshore with increasing freshwater flow during the monsoon season (Smith, et al., 2008).
- The Swatch-of-No-Ground (SoNG) is a 900+ meter deep submarine canyon that incises approximately 65 nm inside the continental shelf in a northeast direction to within 20 nm of the rim of the Sundarbans mangrove forest. The canyon has relatively steep walls (12-15°), ranges from about 40 km wide at its mouth to about 6 km wide at its head, and carries sediments that sustain the world's largest submarine fan (Michels, Suckow, Breitzke, Kudrass, & Kottke, 2003; Subrahmanyam, Krishna, Ramana, & Murthy, 2008). According to a mark-resight analysis under Pollock's robust design of 907 individuals photo-identified during the winter seasons of 2005-2007, a population of about 1,800 Indo-Pacific bottlenose dolphins was estimated to occur in a 2,455 km^2 area at the head of the SoNG (Mansur *et al.* in review). This makes it one of the largest populations assessed of the species. The probability of animals transitioning from an observable state in season 1 to an unobservable state in season 2 was 15.2% or less which may indicate that the actual size of the population is higher than the estimate of 1,800 individuals (Mansur *et al.* in review).
- During the photo-identification study of Indo-Pacific bottlenose dolphins mentioned above eight sightings were made of pantropical spotted dolphins (mean group size = 137, range 20-350) in the far offshore fringes of the study area in waters >100 m deep (Brian D. Smith and Rubaiyat Mansur, unpublished). A single pantropical spotted dolphin group (~800 individuals) was also detected during the 2004 survey of coastal cetaceans at the far offshore and high salinity extreme of survey coverage (Smith, et al., 2008),which only touched the margin of the species' preferred habitat in warm, stratified, pelagic waters see (Perrin & Hohn, 1994). This implies that significant numbers of the species may also occur farther offshore in un-surveyed waters where stratification remains high due to the basin-scale current gyre in the Bay of Bengal (Smith, et al., 2008). During the same the photo-identification study, 14 sightings were made of spinner dolphins (mean group size = 85.0, SD=74.2, range = 2-200) in waters at the outer fringes of the study area >120 m deep (Brian D. Smith and Rubaiyat Mansur, unpublished).
- During 2005-2008, 114 sightings were made of Bryde's whales (mean groups size = 2.3, SD=2.0, range=1-15) in similar habitat as Indo-Pacific bottlenose dolphins at the head of the SoNG (Brian D. Smith and Rubaiyat Mansur, unpublished). A total of 15 individuals were identified from photographs of their dorsal fin, of which six were re-identified during all three seasons (Mahabub, 2008). MtDNA control region data from 38 skin samples collected from these whales indicated that these animals were closely aligned with the "small form" of Bryde's whales (Matt Leslie,

unpublished). Bryde's whales are not known to undergo long-range seasonal migrations and the high, predictable productivity in the SoNG may support a resident population of this species. The common occurrence of calves may also indicate that the area is important for breeding.

- Smith et al., (2008) report that Bryde's whales distribution was closely tied to environmental gradients –occurring where the water is much deeper, oceanically saline and turns from green to blue.
- Although there are no empirical data on the abundance of cetaceans inhabiting the coastal or deep-sea waters on the Indian side of the border of the proposed Offshore Biologically Important Area, similar high densities of cetaceans may be inferred from the existence of similar habitat including freshwater discharge from the Sundarbans and Hooghly River and at western edge of the SoNG.

Number of Supporting Documents[93]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	0	0	0	1	2	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible	0 - Not Applicable
Foraging Area	2 - Eligible	0 - Not Applicable
Breeding / Calving	2 - Eligible	2 - Eligible
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	4 - Eligible	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

[93] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

IUCN Marine Region 12: East Africa

Coastal Waters off Madagascar (Madagascar)

Potential Criteria:	2A: High Density 2B: Breeding and Calving Grounds 2B: Foraging Grounds 2B: Migratory Route 2B: Critical Habitat
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) Blue whale (*Balaenoptera musculus*) Sperm whale (*Physeter macrocephalus*) Beaked whales (family Ziphiidae) Bottlenose dolphins (*Tursiops aduncus, T. truncates*) Indo-Pacific Humpback dolphin (*Sousa chinensis*) Melon-headed whale (*Peponocephala electra*)
Proposed Boundary Consideration:	SME Boundary: All coasts of Madagascar out to 50 nm. *Basis: H. Rosenbaum. Published literature, IWC reports and Wildlife Conservation Society unpublished data. NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.* NMFS boundary on East coast inferred from Pomilla & Rosenbaum (2005): 16° 3'55.04"S, 50°27'12.59"E to 16°12'23.03"S, 51° 3'37.38"E to 24°30'45.06"S, 48°26'0.94"E to 24°15'28.07"S, 47°46'51.16"E to 22°18'0.74"S, 48°14'13.52"E to 20°52'24.12"S, 48°43'13.49"E to 19°22'33.24"S, 49°15'45.47"E to 18°29'46.08"S, 49°37'32.25"E to 17°38'27.89"S, 49°44'27.17"E to 17°24'39.12"S, 49°39'17.03"E to 17°19'35.34"S, 49°54'23.82"E to 16°45'41.71"S, 50°15'56.35"E
Proposed Temporal Consideration:	SME: Year-round NMFS: June – September (East Coast)

Background Provided by SME

- Well documented breeding habitat for humpback whales, with particularly good documentation of dense aggregations in the northeast (Antongil Bay, Isle Ste. Marie), the southeast (Ft. Dauphin), southwest regions (Toliara/Anakao), the Comoros Archipelago off the northeast coast, and suggestions of distribution throughout the entire region (Cerchio, Andrianarivelo, Razafindrakoto, Mendez, & Rosenbaum, 2009; Cerchio et al., 2009; Ersts & Rosenbaum, 2003; Rosenbaum, et al., 2009; Rosenbaum, Walsh, Razafindrakoto, Vely, & Desalle, 1997).
- Presence of sperm whales and beaked whales documented in waters off shelf in the northeast, southwest and northwest regions (Kiszka et al., 2009; Townsend, 1935). Likely foraging grounds in these deep waters.
- Sensitive populations of coastal dolphins, including impacted populations of humpback dolphins, bottlenose dolphins and spinner dolphins off the west coast (Cerchio, Andrianarivelo, et al., 2009). Clearly foraging and breeding habitat for all these non-migratory species.
- High biodiversity documented in the southwest region with 13 different cetacean species due to the close proximity of foraging habitat suitable for both inshore, shallow water species and offshore, deep water species (Cerchio, Andrianarivelo, et al., 2009).
- Documented mass stranding of melon-headed whales off the northeast coast associated with oil and gas exploration activities and the introduction of noise into the regional waters.

- Likely migratory routes for blue whales in the offshore waters off both the east coast and west coast (Mozambique Channel) (Branch, et al., 2007).
- Considered part of the Indian Ocean, Antongil Bay is a haven for humpback whales. Every year between June and September, about 7,000 whales migrate to its coastal waters to breed, calve, and nurse their babies. During this time, the calm of the bay is frequently punctuated by the mating songs of the male whales (WCS, 2010).
- Pomilla and Rosenbaum (Pomilla & Rosenbaum, 2005) have projected migration routes for humpback whales from the Indian to the South Atlantic Ocean passing through the feeding grounds of Madagascar. Their paper, which is the basis of NMFS' boundary consideration, describes humpback whale distribution in the wintering destinations and in the feeding grounds off the coasts of Madagascar.

Number of Supporting Documents[94]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
5	3	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible	0 - Not Applicable
Foraging Area	2 - Eligible	0 - Not Applicable
Breeding / Calving	4 - Eligible	4 - Eligible
Migration Route	3 - Eligible	3 - Eligible
Critical Habitat	0 - Not Applicable[95]	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

[94] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[95] Area does not qualify as critical habitat as defined in the NMFS classification schema.

Madagascar Plateau / Madagascar Ridge / Walters Shoal (Madagascar)

Potential Criteria:	2A: High Density 2B: Foraging Grounds 2B: Migratory Route 2C: Small Distinct Population
Species of Concern:	Pygmy Blue Whale (*Balaenoptera musculus brevicauda*) Humpback Whale (*Megaptera novaeangliae*) Brydes Whale (*Balaenoptera edeni*)
Proposed Boundary Consideration:	SME Boundary inferred from Best et al. (2003), Branch et al. (2007) Approximately 25ºS to 40ºS and 40ºE to 55ºE NMFS' Boundary inferred from Branch et al. (2007) 25°55'20.00"S, 44° 5'15.45"E to 25°46'31.36"S, 47°22'35.90"E to 27° 2'37.71"S, 48° 3'31.08"E to 35°13'51.37"S, 46°26'19.98"E to 35°14'28.59"S, 42°35'49.20"E to 31°36'57.96"S, 42°37'49.35"E to 27°41'11.21"S, 44°30'11.01"E
Proposed Temporal Consideration:	SME: Year-round NMFS: November and December for Blue Whales

Background Provided by SME

- Historic concentrations of catch records of blue whales, likely pygmy blue whale sub-species (Branch, et al., 2007).
- Currently, best documented congregation and feeding area for a pygmy blue whale population in the Indian Ocean, with abundance estimated by line transect distance-sampling at 424 individuals (CV = 0.42) (Best et al., 2003).
- Population identity is likely one of three suspected populations of pygmy blue whales in the Indian Ocean, characterized acoustically by stereotyped "Madagascar" call type (Branch, et al., 2007; McDonald, Mesnick, & Hildebrand, 2006), and restricted to the larger southwest Indian Ocean region (though range extent is currently unknown).
- Documented feeding area and migratory route / stopping area for southwest Indian Ocean population of Humpback whales, Breeding Stock C (Best et al., 1998).
- Documented concentrations of Bryde's whales, they are believed to represent a stock/population/subspecies distinct from two coastal African populations (Best, 2001).
- Additional supporting evidence of seasonality McDonald et al (2006) report that hydrophones off Diego Garcia have recorded blue whale songs south of Madagascar, at 32°S (Ljungblad et al., 1998). The songs were heard in the southern summer (December) on two successive years (McDonald, et al., 2006).

Number of Supporting Documents[96]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
5	0	0	0	0	0	0

[96] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible	1 - Not Eligible
Foraging Area	3 - Eligible	3 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	3 - Eligible	3 - Eligible
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	2 - Eligible	2 - Eligible

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

IUCN Marine Region 13: East Asia

Gulf of Thailand (Thailand, Malaysia, Cambodia)

Potential Criteria:	2A: High Density 2B: Breeding / Calving 2B: Critical Habitat 2C: Small Distinct Population
Species of Concern:	Indo-Pacific humpback dolphin (*Sousa chinensis*) Irrawaddy dolphin (*Orcaella brevirostris*) Finless porpoise (*Neophocaena phocaenoides)*
Proposed Boundary Consideration: *Basis: T. Jefferson*	SME did not submit a spatial file. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The Gulf of Thailand is an area of concentration for three species of coastal small cetaceans that are threatened by human activities: the Indo-Pacific humpback dolphin, Irrawaddy dolphin, and finless porpoise.
- These populations are under stress from serious habitat alteration and unregulated captures for live-display (Beasley, Davidson, Somany, & Ath, 2002; Mahakunlayanakul, 1996).

Number of Supporting Documents[97]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	1	1	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible[98]	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	1 - Not Eligible	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable[99]	0 - Not Applicable
Small Distinct Population	3 - Eligible	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
0	SME did not provide boundary information.

[97] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[98] Proposed criteria for high density based on expert opinion.
[99] Area does not qualify as critical habitat as defined in the NMFS classification schema.

Komodo National Park, Biosphere Reserve (Indonesia)

Potential Criteria:	2A: High Density
Species of Concern:	Omura's whale (*Balaenoptera omurai*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	SME did not submit a spatial file. *Note that some areas are within 12 nm of coastline.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The waters around Komodo Island have been found to contain significant numbers of Omura's whales (*Balaenoptera omurai*). This is a newly-recognized species of baleen whale, which has been subjected to whaling operations by Japan, and currently is of unknown status (Kahn, 2001; Kahn, Wawandono, & Subijanto, 2001).

Number of Supporting Documents[100]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	2	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible[101]	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
0	SME did not provide boundary information.

[100] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[101] Proposed criteria for high density based on expert opinion.

Area in the Ombai Strait in the Savu Sea Marine Protected Area (Indonesia)

Potential Criteria:	2B: Migration Route 2B: Feeding Grounds
Species of Concern:	Blue Whale (*Balaenoptera musculus*); Sperm whale (*Physeter macrocephalus*)
Proposed Boundary Consideration: Location inferred from Pet Soede (2002)	124°19'2.12"E, 8°40'3.814"S to 125°0'5.731"E, 8°32'35.885"S to 124°49'57.827"E, 8°46'59.748"S to 124°26'46.047"E, 8°57'55.645"S Revised Boundary: 8°43'34.99"S, 124°44'17.02"E to 8°40'48.48"S, 124°48'17.19"E to 8°37'2.35"S, 124°51'13.07"E to 8°34'45.48"S, 124°47'21.45"E to 8°37'22.64"S, 124°43'3.46"E to 8°40'52.05"S, 124°38'6.76"E to 8°43'54.81"S, 124°40'25.72"E *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	June through September

Background

- The Indonesian Marine Affairs and Fisheries Minister Freddy Numberi announced the designation of the Savu Sea National Marine Park — a blue whale hotspot, in May 2009. There is little species information on this area. However, The Nature Conservancy has sponsored the Solor-Alor Visual and Acoustic Cetacean Survey & Research Program in this area since 2001. Their studies consider the southeastern cape of Alor and the entrance of Ombai Strait, is considered to be a wide and important migratory corridor between Alor and East Timor (Pet-Soede, 2002).
- Initial comparisons between blue whale sightings south of Alor (Savu Sea) and north of Komodo (Flores Sea) suggests that blue whales enter and exit Indonesian Seas through different routes and corridors; perhaps initially migrating east towards Ombai Strait, between E. Alor and Timor, and then move into the Banda Sea (Pet-Soede, 2002).
- The small passages between the Solor-Alor Islands in the Savu Sea are considered feeding grounds and corridors for cetacean migration (Mustika, 2006).

Number of Supporting Documents[102]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	1	1	1

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	2 - Eligible	1 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	2 - Eligible	2 - Eligible
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[102] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

IUCN Marine Region 15: Northeast Pacific

Beaked Whale Habitat in the Coastal Waters off California, Washington, and Oregon (United States)

Potential Criteria:	2A: High Density 2B: Critical Habitat
Species of Concern:	Beaked whales (*Ziphiidae*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	Bathymetry: Between 550 and 2,000 meter depth contours. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited MacLeod and Mitchell (2005) for support.

Number of Supporting Documents[103]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible[104]	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Eligible[105]	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

[103] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[104] Proposed criteria for high density based on expert opinion.
[105] Area does not qualify as critical habitat as defined in the NMFS classification schema.

Central California National Marine Sanctuaries (United States)

Potential Criteria:	2A: High Density 2B: Foraging Area 2B: Migration Route
Species of Concern:	Blue whale (*Balaenoptera musculus*); Humpback whale (*Megaptera novaeangliae*); Dall's porpoise (*Phocoenoides dalli*); Pacific white-sided dolphin (*Lagenorhynchus obliquidens*); Northern right whale dolphin (*Lissodelphis borealis*); Risso's dolphin (*Grampus griseus*); Eastern gray whale (*Eschrichtius robustus*) Steller sea lion (*Eumetopias jubatus*)
Proposed Boundary Consideration: Location inferred from Forney (2007)	Single stratum boundary created from the Cordell Bank, Gulf of the Farallones, and Monterey Bay legal boundaries.
Proposed Temporal Consideration:	Blue and humpback whale feeding in this area is largely limited to June-November. Gray whales migrate through this area December-May but are likely to be greater than 12 miles from shore only when crossing Monterey Bay. All other species are year-round residents.

Background Provided by SME

- During the summer and fall of 2005, the Southwest Fisheries Science Center conducted a shipboard line-transect survey of marine mammals in the waters off California, Oregon, and Washington out to 300 nm, with fine-scale survey effort in four National Marine Sanctuaries (NMSs), namely the Olympic Coast, Cordell Bank, Gulf of the Farallones, and Monterey Bay NMSs (Forney, 2007). Geographically-stratified line-transect analyses were used to derive density and abundance estimates for three strata with coarse survey coverage (southern California, central and northern California combined, and Oregon and Washington combined) and three strata with fine-scale survey coverage (the Olympic Coast slope, Olympic Coast NMS, and the three central California NMSs combined). Based on the stratified line-transect analyses, the densities in the central California NMS stratum were the highest among all geographic strata for five cetacean species, Dall's porpoise, northern right whale dolphins, Risso's dolphins, humpback whales, and blue whales. Furthermore, the density of Pacific white-sided dolphins in the central California NMS stratum was the second highest among all strata.
- Each fall, gray whales migrate south along the coast of North America from Alaska to Baja California, in Mexico, most of them starting in November or December (Rugh, Shelden, & Schulman-Janiger, 2001). Gray whale northbound migration generally begins in mid-February and continues through May with cows and newborn calves migrating northward primarily between March and June along the U.S. West Coast (Carretta et al., 2008). Gray whales are greater than 12 nm from shore when they migrate across the mouth of Monterey Bay.
- In the Monterey Bay, blue whales feed on dense euphausiid aggregations between 150 and 200 m on the edge of the Monterey Bay Submarine Canyon. (Croll et al., 2005). Blue whale feeding is also particularly common from the Cordell Bank shoreward to Bodega Bay (Barlow & Forney, 2007) and at the southern extent of the Monterey Bay National Marine Sanctuary (Barlow & Forney, 2007).
- Humpback whale feeding is particularly concentrated with the Cordell Bank, Gulf of the Farallon and Monterey Bay National Marine Sanctuaries (Barlow & Forney, 2007; Forney, 2007).
- The cyclic annual migration of the northeastern Pacific blue whale population is associated with feeding at mid- to high-latitudes throughout the highly productive summer and fall, followed by a

southbound migration to tropical regions to give birth and mate in the winter and spring. Primary production off southern California typically peaks in the spring allowing particular euphausiid species to grow to maturity by summer, coinciding with the arrival of blue whales (Burtenshaw et al., 2004).

- Cordell Bank is located about 80 kilometers (50 miles) northwest of San Francisco and 32 kilometers west of the Point Reyes lighthouse. It is approximately 7 kilometers wide and 15 kilometers long and sits on the edge of the continental shelf. The bank is located on the edge of an underwater peninsula and is surrounded by deep water on three sides. Within 11 kilometers of its western edge, the seafloor drops to 1,829 meters at the sanctuary's western boundary (NMS, 2009a).
- Vertical entrapment and/or forcing of prey near the surface likely plays a role in predator aggregation over Cordell Bank. Also, Cordell Bank is shallower than the diurnal depth range of many zooplankton species, especially euphausiids and could vertically trap these prey species in shallow regions within the diving depth of many predators (Yen, Sydeman, & Hyrenbach, 2004)
- Northern fur seals and California sea lions are seasonally abundant in the Cordell Bank NMS, coming here to forage during the fall through the spring.
- Since 1982 Steller sea lion southernmost breeding colonies are within the Monterey Bay and Gulf of the Farallones National Marine Sanctuaries at Año Nuevo Island and the Farallon Islands, respectively. Females and juveniles Steller sea lions stay within the Gulf year-round, while males migrate north and offshore during the non-breeding season from the end of August through May (NMS, 2009c).

Number of Supporting Documents[106]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
7	0	0	0	2	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	4 - Eligible	4 - Eligible
Foraging Area	4 - Eligible	4 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	4 - Eligible	4 - Eligible
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed .

[106] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Vaquita Habitat in the Northern Gulf of California (Mexico)

Potential Criteria:	2C: Small, Distinct Population with Limited Distribution
Species of Concern:	vaquita (*Phocoena sinus*)
Proposed Boundary Consideration: Location inferred from PACE recovery plan	All of the waters in the Gulf of California located north of the line defined by the following coordinates: 114°42'00"W, 30°36'00"N 113°33'00"W, 31°18'54"N
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- The vaquita (also known as the Gulf of California harbor porpoise) is listed as Critically Endangered by the IUCN and as Endangered by both the Mexican Official Standard NOM-059 and the U.S. Endangered Species Act.
- A 2007 abundance estimate suggested that only about 150 individuals remained in the population (Jaramillo-Legorreta et al., 2007), and recent acoustic surveys indicate that the population is currently declining rapidly (Jaramillo-Legorreta & Rojas-Bracho, 2008).
- The range of the vaquita population is very small, limited to the northern Gulf of California (Jaramillo-Legorreta, Rojas-Bracho, & Gerrodette, 1999).
- Vaquitas are occasionally found more than 12 nm from shore.
- The primary and ongoing threat to the vaquita is mortality resulting from bycatch in commercial and artisanal gillnet fisheries for shrimp and fish (CIRVA, 1997, 1999, 2004; Rojas-Bracho & Taylor, 1999).

Number of Supporting Documents[107]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	3	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	4 - Eligible	0 - Not Applicable

[107] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed .

Southern Gulf of California (Mexico)

Potential Criteria:	2A: High Density
Species of Concern:	Cuvier's beaked whale (*Ziphius cavirostris*) Blainville's beaked whale(*Mesoplodon densirostris*) Peruvian beaked whale (*Mesoplodon peruvianus*) Sperm whales (*Physeter macrocephalus*) Coastal spotted dolphin (*Stenella attenuate graffmani*) Long-beaked common dolphin (*Delphinus delphis*) Bottlenose dolphins (*Tursiops truncatus*) Risso's dolphin (*Grampus griseus*) Short-finned pilot whale (*Globicephala macrorhynchus*) Dwarf sperm whale (*Kogia sima*) Bryde's whale (*Balaenoptera edeni*) Fin whale (*Balaenoptera physalus*)
Proposed Boundary Consideration: Location inferred from references cetacean and oceanographic cited in Background material	All of the waters in the southern Gulf of California between 22.88 ^{o}N and 30^{o}N *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically designated area of biological importance.*
Proposed Temporal Consideration:	Year-round

Background Provided by SME

- The southern Gulf of California is an area of particularly high population density[108] for Cuvier's and *Mesoplodon* beaked whales, sperm whales, Bryde's whales, fin whales, coastal spotted dolphins, long-beaked common dolphins, bottlenose dolphins, Risso's dolphins, short-finned pilot whales, and dwarf sperm whales, based on two different analytical methods, geographically stratified line-transect analyses (Ferguson & Barlow, 2001, 2003) and cetacean-habitat models (Ferguson, Barlow, Fiedler, Reilly, & Gerrodette, 2006; Ferguson, Barlow, Reilly, & Gerrodette, 2006). Data for both analyses were based on cetacean sighting data from shipboard line-transect surveys conducted by the Southwest Fisheries Science Center that were designed to study the distribution and abundance of cetaceans.
- The Gulf of California is a narrow sea, with considerable habitat diversity from the northern to the southern end of the Gulf. The Midriff Islands, located between 28^{o}-30^{o} N, separate the shallow (approximately 120 m) northern Gulf from the deep (approximately 2000 m) basin of the southern Gulf (Gutiérrez, Marinone, & Parés-Sierra, 2004).
- Basin-wide eddies that reliably form between the Midriff Islands and the mouth of the Gulf enhances productivity in this region of the Gulf (Pegau, Boss, & Martínez, 2002).
- The northern Gulf (north of approximately 29^{o} N) is characterized by a large-scale, seasonally-reversing gyre (Beier & Ripa, 1999; Carrillo & Palacios-Hernandez, 2002). Collectively, this oceanographic evidence supports placing the boundary between ecosystems in the southern and northern Gulf at approximately 30^{o}N.

[108] Statement based on expert opinion.

Number of Supporting Documents[109]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2- Eligible[110]	1 – Not Eligible
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance.

[109] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[110] Statement based on expert opinion.

Southern California Bight (United States)

Potential Criteria:	2B: Foraging Area 2B: Migration Route
Species of Concern:	Pacific gray whale (*Eschrichtius robustus*) Blue whale (*Balaenoptera musculus*) Short-beaked common dolphin (*Delphinus delphis*) Long-beaked common dolphin (*Delphinus capensis*) Risso's dolphins (*Grampus griseus*)
Proposed Boundary Consideration: Location inferred from Barlow et al. (2009)	120.5°W, 34.5°N to120.5°W, 32°N to 118.605°W, 31.1318°N to 117.8253°W, 32.6269°N to 117.4637°W, 32.5895°N to 117.121°W, 32.507°N
Proposed Temporal Consideration:	Jun through Nov for blue whales, Dec through May for gray whales, year-round for all other species

Background Provided by SME

- The Southern California Bight is a high-density feeding area for a wide variety of cetacean species. The most abundant species is the short-beaked common dolphin, *Delphinus delphis*. The boundaries of this area are taken approximately as the area where *D. delphis* density is estimated to be over 1 animal per km-2 (Barlow et al. 2009). High density areas for other species listed above fall within this zone.
- The waters around the Channel Islands within the Southern California Bight have particularly high densities of Risso's dolphins (Barlow et al. 2009) and long-beaked common dolphins (Barlow & Forney, 2007).
- For blue whales, feeding was noted at a significant fraction of blue whale sightings over the shelf (out to 3.5 km beyond the 200 m isobath) in three areas: around Santa Rosa and San Miguel Islands, north of San Nicolas Island, and along the mainland coast from Pt. Conception north (Fiedler et al., 1998)
- The results of the Whale Habitat and Prey Studies (WHAPS) show that blue whales aggregated near the Channel Islands during the summer, where they feed on dense patches of krill associated with the island shelf. Krill were most abundant along the shelf on the north and west sides of San Miguel Island and the north side of Santa Rosa Island (Fiedler, et al., 1998).
- Blue whales feed off the California coast from roughly June through November, and move southward to waters off Mexico in winter and spring (Calambokidis et al., 1990).
- A study on visual and acoustic encounter rates for blue whales in the SAB reported elevated detection rates of in the Cortez Bank and Butterfly Bank subregions, as the dynamic bathymetry in those regions may concentrate high densities of euphausiids (Oleson, Calambokidis, Barlow, & Hildebrand, 2007). Oleson et al. also notes that the similarity in the visual and acoustic encounter rates in the Cortez Bank and Butterfly Bank subregions suggests that these areas may represent portions of the Bight important to both feeding and traveling whales.
- Each fall, gray whales migrate south along the coast of North America from Alaska to Baja California, in Mexico, most of them starting in November or December (Rugh, et al., 2001). Gray whale northbound migration generally begins in mid-February and continues through May with cows and newborn calves migrating northward primarily between March and June along the U.S. West Coast (Carretta, et al., 2008). Although some gray whales follow the coast in Southern California, many or most are greater than 12 nm from shore when they migrate across the Southern California Bight.

Number of Supporting Documents[111]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
9	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	4 - Eligible	4 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	4 - Eligible	4 - Eligible
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance. .

[111] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Fairweather Grounds, Southeast Alaska (United States)

Potential Criterion:	2B: Foraging Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration: *Basis: NMFS West Coast*	Bounded by 58° 10'N, 58° 30'N, 137° 30'W, and 139° 10'W
Proposed Temporal Consideration:	June through September

Background Provided by SME

- The Fairweather Grounds, located offshore of Mount Fairweather in the Gulf of Alaska, is an offshore bump in the continental shelf waters off Southeast Alaska, rising to within 50 m of the surface. This bathymetric relief provides an area of concentration for fish and zooplankton food sources for humpback whales.
- The Fairweather Grounds has long been recognized as a rich whaling ground (Davidson 1869, Coast Pilot of Alaska, US Govt. Printing Office, Washington D.C.). In that report, the area was described as being from Pamploma Reef eastward to the shores off of Mount Fairweather.
- A recent NOAA survey in 2004 found dense groups of humpback whales feeding in the same area, between 58° 10'N and 58°30'N and between 137°30'W and 139° 10'W, with super-groups of 16, 20 and 25 whales (J. Barlow, pers. comm).
- Local fishermen from Sitka often report seeing whales in the Fairweather Grounds (J. Straley, pers. comm.).
- Most of the Fairweather Grounds is more than 12 nm from shore and thus would be considered an offshore biologically important area for feeding humpback whales.

Number of Supporting Documents[112]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	2	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	2 - Eligible	2 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[112] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Olympic Coast: The Prairie, Barkley Canyon, and Nitnat Canyon (Washington)

Potential Criterion:	2B: Foraging Area
Species of Concern:	Humpback whale (*Megaptera novaeangliae*) Killer whale (*Orcinus orca*)
Proposed Boundary Consideration: Location inferred from Calambokidis et al. (2004)	125°58'38.786"W, 48°30'1.995"N to 125°38'52.052"W, 48°16'55.605"N to 125°17'10.935"W, 48°23'7.353"N to 125°16'42.339"W, 48°12'38.241"N to 125°31'14.517"W, 47°58'20.361"N to 126°6'16.322"W, 47°58'20.361"N to 126°25'48.758"W, 48°9'46.665"N *and existing OBIA boundary as defined in the 2007 Rule.*
Proposed Seasonal Consideration:	June through September

Background

- A CSCAPE survey reported that humpback whale sightings were concentrated in the northern part of the study area between Juan de Fuca Canyon and the outer edge of the continental shelf, an area known as "the Prairie" (Fig. 2). A small area east of the mouth of Barkley Canyon and north of the Nitnat Canyon where the water depth was 125−145 m had a high density of sightings in all years (Calambokidis, Steiger, Ellifrit, Troutman, & Bowlby, 2004). http://www.cascadiaresearch.org/reports/Fish-bul-OCSwEratum.pdf
- NOAA Technical Memorandum 406 estimated that the abundance of humpback whales within the combined three OC strata during 2005 (208, CV=0.28) was about twice the observed abundance during 1995-2000 (range of abundance estimates: 85 - 125, CVs ~0.32), but lower than the peak year of 2002 with 562 (CV=0.21) humpback whales.
- NOAA Technical Memorandum 406 reports that humpback whales were observed largely in the same areas of the OCNMS as during previous years and noted that regions within and to the north (Canadian waters) and west (slope waters) of the OCNMS were likely important foraging regions for West Coast humpback whales.

Number of Supporting Documents[113]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	2 - Eligible	2 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[113] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Gulf of Alaska Steller Sea Lion Critical Habitat (Alaska)

Potential Criterion:	2B: Designated Critical Habitat
Species of Concern:	Steller sea lion (*Eumetopias jubatus*)
Proposed Boundary Consideration: Basis: U.S. Government	Critical habitat includes an aquatic zone that extends 20 nm (37 km) seaward in State and Federally-managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is west of 144°W longitude. 145°43'7.708"W, 60°17'41.42"N to 143°37'31.682"W, 59°38'59.715"N to 146°26'15.838"W, 59°6'38.618"N to 147°34'46.397"W, 59°30'6.865"N to 150°15'53.824"W, 58°57'45.767"N to 151°45'20.388"W, 57°8'1.26"N to 155°30'50.98"W, 55°26'1.094"N to 159°22'19.342"W, 54°24'29.203"N to 162°43'58.85"W, 53°54'32.736"N to 163°23'18.616"W, 54°12'18.436"N to 172°57'38.806"W, 51°40'49.533"N to 179°25'44.364"W, 50°49'26.613"N to 179°39'3.639"W, 51°6'34.253"N to 163°49'34.33"W, 54°21'56.96"N to 157°56'22.112"W, 56°20'3.869"N to 153°11'13.812"W, 58°25'39.894"N to 148°41'53.223"W, 59°49'8.687"N to 148°2'52.488"W, 59°38'59.715"N
Proposed Seasonal Consideration:	Year-Round

Background

- NMFS has designated critical habitat for the Steller sea lion in certain areas and waters of Alaska. Steller sea lions are dependent on these areas and features for its continued existence and any Federal action that may affect these areas or features is subject to the consultation requirements of section 7 of the ESA 58 (58 Federal Register 45269-45285, August 27, 1993).
- Critical habitat includes an aquatic zone that extends 3,000 feet (0.9 km) seaward in State- and Federally-managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is east of 144°W longitude. Critical habitat includes an aquatic zone that extends 20 nm (37 km) seaward in State and Federally-managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is west of 144°W longitude.

Number of Supporting Documents[114]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	4 - Eligible	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[114] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
4	Proposed boundary is well documented and/or codified by national law or regulation (e.g., regulatory boundaries pursuant to the U.S. Endangered Species Act of 1973) and proposed.

Piltun and Chayvo Offshore Feeding Grounds (Russia)

Potential Criteria:	2B: Migration Route 2B: Foraging Area
Species of Concern:	Western Pacific gray whale (*Eschrichtius robustus*)
Proposed Boundary Consideration: Location inferred from IWC and Tyurneva (2006)	143°33'26.5"E, 53°30'42.938"N to 143°40'42.039"E, 53°34'13.683"N to 143°48'39.728"E ,52°41'4.409"N to 143°51'56.423"E, 52°1'44.066"N to 143°24'32.613"E, 52°2'54.314"N to 143°40'13.94"E, 52°38'43.912"N to 143°33'26.5"E, 53°30'42.938"N
Proposed Seasonal Consideration:	June through November

Background

- The critically endangered western gray whale spends the summer-fall open water period feeding off northeast Sakhalin Island (Rutenko, Borisov, Gritsenko, & Jenkerson, 2007). A previously unknown gray whale feeding area (the Offshore feeding area) was discovered south and offshore from the nearshore Piltun feeding area. The Offshore area has subsequently been shown to be used by feeding gray whales during several years when no anthropogenic activity occurred near the Piltun feeding area (S. Johnson et al., 2007).
- Results of a 2001-2003 aerial survey of the area indicated that gray whales occurred in predominantly two areas, (1) adjacent to Piltun Bay, and (2) offshore from Chayvo Bay (offshore feeding areas). In the Piltun feeding area, the majority of whales were observed in waters shallower than 20 m and were distributed from several hundred meters to similar to 5 km from the shoreline.
- In the offshore feeding area during all years, the distribution of gray whales extended from southwest to northeast in waters 30-65 m in depth. Fluctuations in the number of whales observed within the Piltun and offshore feeding areas and few sightings outside of these two areas indicate that gray whales move between the Piltun and offshore feeding areas during their summer-fall feeding season. Seasonal shifts in the distribution and abundance of gray whales between and within both the Piltun and offshore feeding areas are thought, in part, to be a response to seasonal changes in the distribution and abundance of prey (Meier et al., 2007).

Number of Supporting Documents[115]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	3 - Eligible	3 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	1- Not Eligible	1- Not Eligible
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[115] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

IUCN Marine Region 16: Northwest Pacific

Okhotsk Sea (Russia)

Potential Criteria:	2B: Foraging Area 2B: Migration Route
Species of Concern:	Fin whale (*Balaenoptera physalus*) Minke whale (*Balaenoptera acutorostrata*) North Pacific Humpback whale (*Megaptera novaeangliae*) Western Pacific Right whale (*Eubalaena japonica*) Okhotsk Sea bowhead whale (*Balaena mysticetus*) Baird's beaked whale (*Berardius bairdii*) Dall's porpoise (*Phocoenoides dalli*)
Proposed Boundary Consideration: *Basis: NMFS West Coast*	SME did not submit a spatial file. ** NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- A separate population of bowhead whales is restricted to the Okhotsk Sea. During the late spring and early summer these whales concentrate in Shelikhov Bay in the northeastern Okhotsk Sea and then are found from May to October in the Shantar region of the northwestern Okhotsk Sea. However, little is known about their winter distribution, but these whales do not leave the Okhotsk Sea. These concentrations are found within the 12 nm of the coast. The population is estimated in the low hundreds, but this is not based on any quantitative analysis.
- The western population of right whales summers and feeds in the Okhotsk Sea mainly off southern Sakhalin Island and the western side of the Kamchatka Peninsula. The population was depleted during 19th century whaling and again by Soviet whaling in the 1960s. Based on summer sightings during a Japanese-Russian surveys in the Okhotsk Sea in Miyashita and Kato (1998) derived a population estimate of 922 whales (95% CI 404-2,108) using line transect analysis.
- Fin whales seem to be abundant in the central offshore part of the Okhotsk Sea based on recent Japanese surveys, but no abundance estimate has been calculated (Miyashita, 2004).
- A joint Japanese-Russian surveys in the summers of 1989 and 1990 yielded an abundance estimate for western North Pacific minke whales of 25,049 (CV 0.316), but most of these whales (19,209; CV 0.339) were found in the Okhotsk Sea (Buckland, Cattanach, & Miyashita, 1992). The Okhotsk Sea has been surveyed again in 2003 (Miyashita, 2004), but no updated abundance estimate has been derived.
- The main summer feeding grounds for the western North Pacific humpback whales are the waters off easternmost Russian, including the western Bering Sea, the Okhotsk Sea, south to the Sanriku coast of Honshu, Japan (Rice, 1998) [plus any new SPLASH data population estimate of ca. 1,000 whales]).
- Three species of beaked whales (*Z. cavirostris*, *B. bairdii*, and *M. steinegeri*) are known from the waters of the Russian Far East (Tomilin, 1967). The first stranding of a Cuvier's beaked whale was in 1882 from Bering Island, Commander Islands and this specimen is the holotype of *Ziphius grebnitzkii* (Stejneger 1883). Most of the strandings for these species are from the Commander Islands where Cuvier's beaked whale is the most frequently found (Tomilin, 1967).
- Dall's porpoise are recognized as two different color type: the dalli-type and the truei-type. Based on 2003 survey data the population estimates for dalli-type and truei-type porpoises are 173,638 and

178,157, respectively (GOJ, 2007). The true-type breed in the central part of the Okhotsk Sea in summer.

Number of Supporting Documents[116]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
7	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	4 - Eligible	4 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	2- Eligible	2- Eligible
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
0	SME did not provide boundary information.

[116] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Exclusion around Japan and the Ryukyu Islands (Japan)

Potential Criteria:	SME did not submit criteria. (NMFS West Coast) 2A: High Density (TJ) 2B: Critical Habitat (TJ)
Species of Concern:	At least 39 species of cetaceans, including eight species of baleen whales, seven species of beaked whales are known from Japanese waters. Beaked whales (*Ziphiidae*) (TJ)
Proposed Boundary Consideration: *Basis: NMFS West Coast or T. Jefferson*	Exclusion around the main Japanese Islands and Ryukyu Islands, extending 100 km (54 nm) seaward of the 12 nm border along the Pacific side (eastern coastline of Japan) and extending 100 km on both sides of the Ryukyu Islands (Okinawa, Kerama, Miiyako, Yaeyama, Kume, Iriomote, and Ishigaki). Bathymetry: between 550 and 2,000 meter depth contours. (TJ) *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The Japanese Archipelago is the world's seventh largest island. The waters around the Japanese Islands have a large diversity of cetaceans because of a distant cool-temperate and warm-temperate fauna to the north and to the south, respectively. The cold water along the northern half of Japan is from the Oyashio Current which supports the Oyashio Large Marine Ecosystem (OLME). The OLME is one of the most productive ecosystems in the North Pacific Ocean (Minoda, 1989). Along the southern half of Japan warmer waters are found from the Kuroshio Current which supports the Kuroshio Large Marine Ecosystem and extends south to its origin off the Philippines.
- At least 39 species of cetaceans are found within these two large marine ecosystems in the Japanese EEZ, including many ecologically and genetically distinct populations. (e.g., (Fujino, 1960; Hayano, 2004, 2007; Ichihara, 1957b; Kasuya & Miyashita, 1988, 1997; Kasuya, Miyashita, & Kasamatsu, 1988; Kasuya & Tai, 1993; Kato, 1992; Miyazaki & Amano, 1994; Miyazaki & Nakayama, 1989; Wada, 1988).
- Eight species of baleen whales (fin whales, sei whales, minke whales, Bryde's whales, Omura's whales, humpback whales, gray whales and North Pacific right whales) are known from Japanese waters.
- In the western North Pacific, there are at least two distinct populations of minke whale. The "J stock" which appears to be an autumn-breeding population that occurs in the Yellow Sea, East China Sea and Sea of Japan. They also occur at least seasonally in the coastal waters along the Pacific coast of Japan with limited penetration into the Okhotsk Sea in summer; The other population is the "O-stock" which breeds in winter like most baleen whales, and occurs in summer in the northwestern Pacific including the northeastern coasts of Japan, and in the Okhotsk Sea, but the "J stock" with a with conception peak in the fall (Kato, 1992; Omura & Sakiura, 1956). J stock whales are found out to at least 50 nm from the Pacific coast of Japan. The population is considered depleted because of past commercial whaling and current bycatch in both Korean and Japanese waters.
- Seven species of beaked whales (*I. pacificus*, *B. bairdii*, *Z. cavirostris*, *M. carlhubbsi*, *M. densirostris*, *M. ginkodens*, *M. stejnegeri*) are known from Japanese waters. Longman's beaked whale was not recorded until July 2002 at Sendai-shi, Kyushu (Yamada). Three of these species (*B. bairdii*, *M.*

carlhubbsi, and *M. stejnegeri*) are restriched to the cold waters of the Oyashio Current and the others are found in the warm Kuroshio Current to the south of 35 N. Cuvier's beaked whales are found in all waters around Japan and six mass strandings (with three or more individuals) of these whales occurred in Sagami Bay and Suruga Bay between 1963 and 1990 (Brownell, Yamada, Mead, & Van Helden, 2004).

- Baird's beaked whales are found off the slope of the eastern coast of Japan to about 35 N. Vessel surveys were conducted between 1983 and 1991 and in 1992. These surveys produced Overall abundance estimates of 4,220 and 5,029, respectively (Miyashita, 1986; Miyashita & Kato, 1993). No abundance estimates are available for any of the other species of beaked whales in Japanese waters and little is known about these actual distributions except from stranded animals.
- Miyashita (1993) estimated population size of the northern form of the short-finned pilot whales in the cold water Oyashio Current off the NE coast of Japan, based on summer surveys in 1982 through 1988 was 4,239 (CV=0.61).
- Dall's porpoise are found only in the North Pacific and two forms are found in the west. These are the dalli-type found along the east side of Japan north of 35 N. and the truei-type known from northern Japan and southern half of the Okhotsk Sea. Based on 2003, abundance estimates for the dalli-type and truei-type were 173,638 and 178,157, respectively (GOJ, 2007). During the winter the truei-type are found in the Oyashio Current offshore from Choshi, Japan to Hokkiado, Japan but in the summer they move to the central Okhotsk Sea. The dalli-type spend the winter in the northern part of the Sea of Japan north of the Shimane Pref. and breed in the Okhotsk Sea.
- Miyashita (1993) estimated the population size of the northern form of the short-finned pilot whales in the cold water Oyashio Current off the NE coast of Japan, based on summer surveys in 1982 through 1988, was 4,239 (CV=0.61).
- Dall's porpoise are found only in the North Pacific and two forms are found in Japanese waters. These are the dalli-type found along the east side of Japan north of 35° N. and the truei-type known from northern Japan and the southern half of the Okhotsk Sea. Based on surveys in 2003, abundance estimates for the dalli-type and truei-type were 173,638 and 178,157, respectively (GOJ, 2007). During the winter the truei-type are found in the Oyashio Current offshore from Choshi, Japan to Hokkaido, Japan but in the summer they move to the central Okhotsk Sea. The dalli-type spends the winter in the northern part of the Sea of Japan (north of the Shimane Pref.) and breed in the Okhotsk Sea.
- Other small cetaceans found in the Oyashio Current include: short-beaked dolphins, striped dolphins, common bottlenose dolphins, Risso's dolphins, northern right whale dolphins, Pacific white-sided dolphins, false killer whales, and killer whales.
- Small cetaceans in the Kuroshio Current in Japanese waters south of 34° N are the tropical and warm-temperate species found worldwide in these types of waters. Some of the more abundant small cetaceans here include: striped dolphins, spotted dolphins, common bottlenose dolphins, Risso's dolphins, southern short-finned pilot whales, and false killer whales. These species are well studied off Japan because they are taken by the Japanese drive fishery. Based on Japanese sightings surveys from 1983 to 1991 in the waters off Japan, population estimates were made for these six species (Miyashita, 1993). These are summarized below:
- Striped dolphins were found in August and September in three geographic concentrations in waters between 25°N - 41°N and 135°E to 180°. The total population estimate for this area was 570,000 (CV=0.18). Spotted dolphins were found in August and September and most were concentrated north of 30°. The area surveyed was between 25ºN-38ºN and west of 180º. The total population estimate for the area was 438,000 (CV=0.17).
- Common bottlenose dolphins were found in August and September in waters between 30ºN - 42ºN and west to 160ºE. The total population estimate for the area was 168,000 (CV=0.26).

- Risso's dolphins were found in three concentrations in waters south of 40ºN and west of 180º but their southern boundary was not determined during the surveys. The total abundance estimate was 838,000 (CV=0.17).
- The population size for southern form of short-finned pilot whales was estimated at 53,000 (CV=0.22) during the months of August and September in coastal and offshore waters west to 165ºE and between 25ºN - 36ºN.
- False killer whales were found in generally the same area as the short-finned pilot whales but their northern limit was more southern at 39ºN. The total abundance estimate was 16,000 (CV=0.26).
- Other small cetaceans found in the Kuroshio Current include the following: long-beaked common dolphins, pygmy killer whale, Fraser's dolphins, killer whales, melon-headed whales, spinner dolphins and rough-toothed dolphins. The melon-headed whales is known from nine mass stranding events in Japanese waters south of 36° N between 1982 and 2006 (Brownell, Yamada, Mead, & Allen, 2006).
- Also, the Indo-Pacific bottlenose dolphin is found in small seven discontinuous, isolated populations, within the main Japanese islands and offshore islands, in the Kuroshio Current. These populations are: (1) in the Bungo Channel, Amakusa (Shirakihara, Shirakihara, Tomonaga, & Takatsuki, 2002) (2) Kagoshima Bay (Nanbu, Hirose, Kubo, Kishiro, & Shinomiya, 2006) (3) in the Sea of Japan, around Noto-jima (Mori, 2005) (Mori and Yoshioka 2009), (4) Mikura Island and (6) Ogasawara Islands (Mori *et al*. 2005). Mikura and Ogasawara are about 200 km and about 1,000 km, respectively, southeast of Tokyo. The seventh population is in the waters around the Amami Islands which are part of the Ryukyu Islands chain (Miyazaki and Nakayama 1989). Most of these Indo-Pacific bottlenose dolphins, like in other populations throughout their range, are year-around residents (Mori and Yoshioka 2009).
- Eight species of pinnipeds (Kurile harbor seal, larga seal, ringed seal, ribbon seal, bearded seal, and northern fur seal) including one endangered one (Steller sea lion) and one extinct species (Japanese sea lion) are known from northern Japanese waters, mainly in the southern Okhotsk Sea off the northern coast on Hokkaido.

Number of Supporting Documents[117]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
8	3	0	0	0	8	3

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Eligible[118]	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[117] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.
[118] Area does not qualify as critical habitat as defined in the NMFS classification schema.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

The Sea of Japan (Japan)

Potential Criteria:	SME did not submit criteria. (NMFS West Coast) 2A: High Density (TJ)
Species of Concern:	Finless porpoise (*Neophocaena phocaenoides*) (NMFS West Coast) Beaked whales (*Ziphiidae*) (TJ)
Proposed Boundary Consideration: *Basis: NMFS West Coast or T. Jefferson*	Total exclusion within the Sea of Japan, extending seaward of the 12 nm borders of the Korean Peninsula and Japan. Bathymetry: between 550 and 2,000 meter depth contours. (TJ) *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The cetaceans, including both baleen whales and small cetaceans, found in the Sea of Japan approximately north from the southern end of the Korean Peninsula are the same as those found in the Oyashio Large Marine Ecosystem and the cetaceans to the south of the Korean Peninsula are the same as those found in the Kuroshio Large Marine Ecosystem.
- Finless porpoise are found outside the 12 nm zone of the Sea of Japan because of the shallow nature of this region. Anon. (2005) reported that "In the offshore waters (33°00′ to 37°30′N, 122°00′ to 126°00′E), two sighting surveys were conducted using the R/V Tamgu-3 in 2001 and 2004." Anon. (2005) also says that "Park reported the stock status in the Korean waters based on the abundance estimate. 2 shipboard surveys for finless porpoise were made in each offshore and inshore of the west coast of Korea. The first surveys in offshore and inshore were carried out in each 2001 and 2003 estimated an abundance of 58,650 animals in offshore and 1,571 porpoises in inshore. In 2004, it was estimated that current abundance was 21,532 animals in offshore and 5,464 porpoises in inshore."

Number of Supporting Documents[119]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	2 - Eligible	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[119] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Total Exclusion within the Yellow Sea / East China Sea (China, North Korea, South Korea)

Potential Criteria:	SME did not submit criteria.
Species of Concern:	Gray whale (*Eschrichtius robustus*); Minke whale (*Balaenoptera acutorostrata*); Fin whale (*Balaenoptera physalus*); Humpback whale (*Megaptera novaeangliae*); Omura's whale (*Balaenoptera omurai*)
Proposed Boundary Consideration: *Basis: NMFS West Coast*	Total exclusion within the Yellow Sea and East China Sea (China) extending seaward of the 12 nm borders of the Korean Peninsula, China and Japan. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The Yellow Sea Large Marine Ecosystem is a semi-enclosed Sea bordered by three countries: China, North Korea and South Korea. The southern Yellow Sea is adjacent to the East China Sea Large Marine Ecosystem which is also a semi-enclosed body of water bordered by China, South Korean and Japan. The southern limit of the East China Sea connects to the Taiwan Strait. The warm Tsushima Current, a branch of the Kuroshio Current, is a major influence in the ECS ecosystem.
- The main baleen whales known to occur in the inshore waters are: gray whales, minke whales, fin whales and humpback whales (Zhou, 2004). In addition, Omura's whales should also be present in the coastal and offshore regions of the ECS but not the Yellow Sea (Yamada, 2009).
- A resident population of fin whales, depleted from past commercial whaling operations, is found in both the Yellow Sea and the East China Sea (Fujino, 1960). Ichihara (1957a) reported differences in the general shapes of fin whales between the western Aleutian Islands and the northern part of the East China Sea.
- Three species of beaked whales (Baird's beaked whales, Blainville's beaked whales, and gingko-toothed beaked whales) are recorded from Chinese waters (P. Wang, 1999; Zhou, 2004). No abundance estimates are available for any of these species in Chinese waters and little is known about their actual distribution except from stranded animals.

Number of Supporting Documents[120]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	5	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable

[120] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Exclusion around Taiwan (China)

Potential Criteria:	SME did not submit criteria.
Species of Concern:	SME did not submit any species information.
Proposed Boundary Consideration: *Basis: NMFS West Coast*	Exclusion around Taiwan, extending 100 km (54 nm) seaward of the 12 nm border along the Pacific side (eastern coastline of Taiwan). *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Historically, the humpback whale was the most important baleen whale in Taiwanese waters, but the population was greatly depleted by commercial whalers during the first half of the 20th century.
- Additional baleen whales include minke whales, Bryde's whales and Omura's whales, but gray whales have not been confirmed from Taiwanese waters. All of the small cetaceans listed above from the Kuroshio Large Marine Ecosystem are also found in the same current off the east coast of Taiwan (J. Wang & Yang, 2007) and southward to the Philippines (Dolar, Perrin, Taylor, Kooyman, & Alava, 2006).
- Deep water is found close to shore off the eastern and southern coast of Taiwan. Population estimates are not available for these waters, but small cetaceans are abundant and form the core of the local whale-watching operations along the east coast of Taiwan. Also the same species within distant regions of the Kuroshio Large Marine Ecosystem are different populations and therefore must be assessed and managed separately (Perrin, Dolar, Amano, & Hayano, 2003).
- One of these species, the pygmy killer whale is known from six mass stranding events from the southwestern region of the island between 1995 and 2005 and an additional three near mass stranding events (Brownell et al., 2009). Additional MSEs in Taiwan are known for melon-headed whales, rough-toothed dolphins, and short-finned pilot whales (J. Wang & Yang, 2007).

Number of Supporting Documents[121]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[121] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Exclusion in the South China Sea (China)

Potential Criteria:	SME did not submit criteria. (NMFS West Coast) 2A: High Density (TJ)
Species of Concern:	Misc. Species (TJ)
Proposed Boundary Consideration: *Basis: NMFS West Coast or T. Jefferson*	Bathymetry: 100 km seaward of the shallow water area (NMFS West Coast) Continental shelf. (TJ) *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- The main character of the South China Sea Large Marine Ecosystem (SCS) is its tropical climate. The countries bordering the SCS are: Vietnam, China, Taiwan, the Philippines, Malaysia, Thailand, Indonesia and Cambodia.
- The SCS is divided into two major areas: (1) a coastal region less them 200 m from the coast out to about 100 km and (2) a deep water region to the east of the shallow water area.
- The cetaceans found in the shallow waters are not well known and mainly consist of Indo-Pacific bottlenose dolphins, common bottlenose dolphins, Pacific humpbacked dolphins and finless porpoise.
- The offshore cetacean fauna are the same species found in the Kuroshio Large Marine Ecosystem. The main baleen whales known to occur in the offshore waters of the SCS are Bryde's whales and some humpback whales in the northeastern most SCS.
- Within the coastal region the following species have been recorded: gray whales, minke whale, fin whales and humpback whales (Zhou, 2004). In addition, Omura's whales should also be present in the coastal and offshore regions of the SCS (Yamada, 2009).

Number of Supporting Documents[122]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	2	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[122] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Total Exclusion in the Gulf of Tonkin (Vietnam)

Potential Criteria:	None submitted.
Species of Concern:	Indo-Pacific humpback dolphin (*Sousa chinensis*) Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) Finless porpoise (*Neophocaena phocaenoides*)
Proposed Boundary Consideration: *Basis: NMFS West Coast*	Seaward of the 12 nm borders of Vietnam and China *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- This region is the northwest arm of the South China Sea and is bounded by China to the north and east (Hainan Island) and northern Vietnam to the west. Its size is about 500 km long and 250 km wide with waters only to 70 m deep.
- The Vietnam cetacean fauna is poorly known except for coastal small cetaceans like Indo-Pacific humpback dolphin, Indo-Pacific bottlenose dolphin and finless porpoise (Smith et al., 1995).
- Other species of small cetaceans from the Kuroshio Large Marine Ecosystem are reported from Vietnam but the locations and densities are unknown. Most records from Vietnam are whales that likely stranded near the 'Whale Temples" where their bones were deposited (Smith, et al., 1995).
- The area outside the 2 nm EEZ could be an important wintering region for some of the critically endangered western gray whales and western North Pacific humpback whales (Zhou, 2004).

Number of Supporting Documents[123]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
0	0	0	0	0	2	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

[123] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

Exclusion around Wake Island (United States)

Potential Criteria:	None submitted.
Species of Concern:	None submitted.
Proposed Boundary Consideration: *Basis: NMFS West Coast*	An area extending 100 km seaward of the 12 nm EEZ. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- Wake Island is the most northern of the Marshall Island chain. It is part of Wake Atoll, which consists of three fringing islands, Wake, Wilkes, and Peale, with a total land area of 6.5 km^2.
- The cetacean fauna in the waters around Wake is poorly known and only three species have been recorded (Brownell & Ralls, 2008). No abundance estimates are available for any of these species.
- Two Cuvier's beaked whales stranded live on Wake Island in January and February 1977 (PIRO Stranding database). Blue whales have been recorded near Wake (McDonald, et al., 2006; Stafford, Nieukirk, & Fox, 2001; Watkins et al., 2000), as have fin whales (Northrop, Cummings, & Thompson, 1967). Stafford *et al*. (2001) believed that some of the calls they reported near Wake were the Eastern Type, but it is now clear that the blue whale song type around Wake is exclusively the Western Type (M. McDonald, pers. comm.).

Number of Supporting Documents[124]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	0	0	1	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

[124] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Exclusion for the North Philippine Sea (Philippines)

Potential Criteria:	2A: High Density
Species of Concern:	Misc. species
Proposed Boundary Consideration: *Basis: T. Jefferson*	Bathymetry: to the 1,000 meter depth contour. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited Dolar (1999) and Dolar et al. (2006).

Number of Supporting Documents[125]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	1	0	0

1.2

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

[125] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Exclusion for the West Philippine Sea (Philippines)

Potential Criteria:	2A: High Density
Species of Concern:	Misc. species
Proposed Boundary Consideration: *Basis: T. Jefferson*	Bathymetry: to the 1,000 meter depth contour. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited Dolar (1999) and Dolar et al. (2006).

Number of Supporting Documents[126]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
1	0	0	0	1	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

[126] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Exclusion for the East China Sea (China)

Potential Criteria:	2A: High Density
Species of Concern:	Baleen whales (*Mysticeti*)
Proposed Boundary Consideration: *Basis: T. Jefferson*	The continental shelf. *NMFS: The proposed boundary appears to have a buffer zone that extends beyond the specifically identified area of biological importance.*
Proposed Temporal Consideration:	SME did not submit a temporal restriction.

Background Provided by SME

- SME cited (Zhou, Leatherwood, & Jefferson, 1995) and (Zhou, 2002).

Number of Supporting Documents[127]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	1 - Not Eligible	1 - Not Eligible
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
1	Clear justification (qualitative or quantitative) for boundary consideration is not available or SME did not provide sufficient detail to NMFS for appropriate boundary evaluation.

[127] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

IUCN Marine Region 17: Southeast Pacific

Penguin Bank (Hawaii)

Potential Criteria:	2A: High Density 2B: Breeding Area
Species of Concern:	Humpback whales (*Megaptera novaeangliae*)
Proposed Boundary Consideration: Location inferred from Mobley (2001)	157°30'58.217"W, 21°10'2.179"N to 157°30'22.367"W, 21°9'46.815"N to 157°31'0.778"W, 21°6'39.882"N to 157°30'30.049"W, 21°2'51.976"N to 157°29'28.591"W, 20°59'52.725"N to 157°27'35.919"W, 20°58'5.174"N to 157°30'58.217"W, 20°55'49.456"N to 157°42'42.418"W, 20°50'44.729"N to 157°44'45.333"W, 20°51'2.654"N to 157°46'4.716"W, 20°53'56.784"N to 157°45'33.987"W, 20°56'32.988"N to 157°43'10.586"W, 21°1'27.472"N to 157°39'27.802"W, 21°5'20.499"N to 157°30'58.217"W, 21°10'2.179" *This area is within a nationally-designated marine mammal sanctuary.*
Proposed Seasonal Consideration:	January through April

Background

- The Hawaiian Islands Humpback Whale National Marine Sanctuary was created by Congress in 1992 to protect humpback whales and their habitat in Hawai'i. The sanctuary, which lies within the shallow (less than 600 feet), warm waters surrounding the main Hawaiian Islands, constitutes one of the world's most important humpback whale habitats (http://hawaiihumpbackwhale.noaa.gov/about/welcome.html)
- With the exception of a portion of Penguin Banks, the Hawaiian Islands Humpback Whale National Marine Sanctuary is located within 12 nautical miles (nm) of the islands. Penguin Bank is a shallow area of known humpback whale concentration (Mate, Gisiner, & Mobley, 1998).
- The primary period of humpback whale presence in Hawaiian waters is January through April, with peak abundance occurring earlier near the island of Hawai'i than the other islands (Gabriele, Rickards, Yin, & Frankel, 2003). Their report identified the highest whale densities near Keahole Point and just north of Kawaihae Harbor, and lower densities near the resorts along the shore south of Kawaihae (Gabriele, et al., 2003).
- The main Hawaiian Islands (MHI) are the primary winter reproductive area for the majority of North Pacific humpback whales. Identification photographs of individual whales, including 63 females sighted in at least 2 different years and with at least 1 calf, were collected from waters off the islands of Maui and Hawaii between 1977 and 1994 (Craig & Herman, 2000).
- Calves formed a significantly larger proportion of the population off Maui than off the Big Island. The overall proportion of calves to all whales identified (crude birth rate) was 0.099 off Maui and 0.061 off the Big Island (Craig & Herman, 2000).
- Aerial surveys conducted in Hawaiian waters during the winter months (Jan-Apr) of 1976-80 showed humpbacks to be most prevalent in coastal regions and shallow banks where the expanse of water less than 100-fathoms (183 m) was more extensive. Greatest densities of adult humpbacks and calf pods were found in the "four island region" (FIR) consisting of Maui, Molokai, Kahoolawe and Lanai, as well as Penguin Bank (Mobley et al., 2001).
- Mobley, Bauer and Herman (1999) confirmed the earlier preference of both adult humpbacks and calf pods for the FIR and Penguin Bank regions, but also showed a substantial increase of adult humpbacks in the Kauai/Niihau region (Mobley, et al., 2001).

Number of Supporting Documents[128]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
4	0	0	0	0	1	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	3 - Eligible	3 – Eligible
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	3 - Eligible	3 – Eligible
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at quantifying a core area of biological significance

[128] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Cross Seamount (United States)

Potential Criteria:	2B: Foraging Area
Species of Concern:	Cuvier's beaked whales (*Ziphius cavirostris*) Blainville's beaked whales (*Mesoplodon densirostris*)
Proposed Boundary Consideration:	18° 36′ N, 158° 26′ W 18° 36′ N, 158° 6′ W 18° 50′ N, 158° 26′ W 18° 50′ N, 158° 6′ W
Proposed Temporal Consideration:	Year-round, but particularly at night.

Background Provided by NMFS

- Cross Seamount is located at 18° 41′ N and 158° 18′ W in the central Pacific Ocean. The summit is approximately 5 by 7km across and ranges in depth between 450 and 350m.
- Johnston et al. (2008) conducted passive acoustic monitoring at Cross Seamount between 26 April 2005 and 19 November 2005 using a high-frequency acoustic recording package to detect odontocete echolocation sweeps. Visual examination of scrolling spectrograms from these data discovered that the most frequently detected cetacean signals were echolocation sweeps similar to those produced by Cuvier's beaked whales or Blainville's beaked whales. Almost all detections occurred during the night.
- Acoustic backscatter data indicate higher densities of organisms over the seamount and at its flanks relative to those in ambient water and show a prominent diel cycle due to vertical migratory behavior of sound scattering organisms.
- Feeding buzzes that were not frequency modulated were also occasionally associated with the echolocation signals described in the article, somewhat resembling those known to be associated with Cuvier's and Blainville's beaked whale echolocation sounds (Johnson et al. 2004).
- Highest densities over the plateau were observed during the night-time, with a prominent SSL in the upper 200m and dense patches of aggregations near the seafloor of the seamount. Trawl surveys of SSL layers in this region revealed squid and fishes, which are potential prey items for beaked whales.
- Their acoustic monitoring reveals that beaked whales foraged at Cross Seamount during most nights. The detection range (based on seafloor reflections) for these signals appears to be less than 5km, thus detected animals were at the seamount summit. Few beaked whale detections occurred during daylight hours, and several hypotheses may explain this pattern. It is possible that the whales were not present at Cross during the day or that the whales were present in the area but not echolocating. It is also possible that the whales were present, but diving past the summit of the seamount before echolocating at depth.
- It is possible that dense concentrations of prey at Cross may reduce diving demands for beaked whales, allowing them to spend greater time foraging at depth. In this case, the presence of the seamount summit may facilitate prey capture by providing a barrier against which whales concentrate prey. The author further hypothesizes that this may stem from the enhancement of local productivity by ‘seamount effects’, providing predictable patches of prey in an otherwise dilute and oligotrophic environment (Johnston, et al., 2008).
- Johnson et al. (2004) attached acoustic tags to four beaked whales (two *Mesoplodon densirostris* and two *Ziphius cavirostris*) and recorded high–frequency clicks during deep dives. The tagged whales only clicked at depths below 200 m, down to a maximum depth of 1267 m. Both species produced a large number of short, directional, ultrasonic clicks with no significant energy below 20 kHz. The tags recorded echoes from prey items; to the author’s knowledge, a first for any animal echolocating in the wild. They conclude that these echoes provide the first direct evidence on how free-ranging

toothed whales use echolocation in foraging. The strength of these echoes suggests that the source level of *Mesoplodon* clicks is in the range of 200–220 dB re 1 µPa at 1 m.

- The mesopelagic community over the summit contains two species that appear to be found in higher abundance over the summit as opposed to away and may be considered as seamount-associated species. These are a cranchiid squid, *Liocranchia reinhardti*, and a myctophid fish, *Benthosema fibulatum*. This seamount is known to impact the mesopelagic micronekton community and tuna community, but the mechanisms behind these impacts are largely unknown at this time (De Forest & Drazen, 2009).

Number of Supporting Documents[129]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
3	0	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	3 - Eligible	0 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
3	Proposed boundary inferred from peer-reviewed analysis, habitat suitability models (peer-reviewed), or a survey specifically aimed at investigating and supporting the proposed boundary. Boundary surrounds the location of a core biological area of importance.

[129] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

Costa Rica Dome (Costa Rica, Panama)

Potential Criteria:	2B: Foraging Area 2B: Wintering Ground
Species of Concern:	Blue whale (Balaenoptera musculus) Humpback whale (*Megaptera novaeangliae*)
Proposed Boundary Consideration:	Existing boundary as defined in the 2007 Final Rule.
Proposed Seasonal Consideration:	Year-Round

Background

- The distribution of blue whales, in the eastern tropical Pacific (ETP) was analyzed from 211 sightings of 355 whales recorded during research vessel sighting surveys or by biologists aboard fishing vessels. Over 90% of the sightings were made in just two areas: along Baja California, and in the vicinity of the Costa Rica Dome. All sightings occurred in relatively cool, upwelling-modified waters. The Costa Rica Dome area was occupied year round, suggesting either a resident population, or that both northern and southern hemisphere whales visit with temporal overlap (Reilly & Thayer, 1990).
- Research conducted in the 1990s reported that some humpback whales from the North Pacific were also using Costa Rican waters as a wintering ground (Acevedo-Gutiérrez & Smultea, 1995).
- With blue whales, the greatest unknown is whether their year-round residency on the Costa Rica Dome is indicative of a distinct, non-migratory population segment or whether some individuals may choose not to migrate every year (Calambokidis, et al., 1990).

Number of Supporting Documents[130]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	1	0	0	0	0	0

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	3 - Eligible	3 - Not Applicable
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

[130] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

IUCN Marine Region 18: Australia – New Zealand

Great Barrier Reef Between 16°S and 21°S (Australia)

Potential Criterion:	2B: Breeding Ground
Species of Concern:	Humpback whale (Megaptera novaeangliae) Dwarf Minke whale (Balaenoptera acutorostrata)
Proposed Boundary Consideration: Location inferred from Arnold (1997)	145°38'46.988"E, 16°1'49.75"S to 146°20'56.18"E, 15°52'12.917"S to 146°59'23.514"E, 17°28'21.251"S to 151°39'40.427"E, 20°16'13.65"S to 150°30'53.849"E, 20°58'22.843"S to 146°49'46.681"E, 18°51'10.893"S to 145°38'46.988"E ,16°1'49.75"S
Proposed Seasonal Consideration:	May through September

Background

- Of particular concern in the Marine Park is a population of dwarf minke whales occurring off northern Queensland, most often seen in the Ribbon Reefs area in June and July although present in the Park from about May to October (GBRMP, 2000).
- An IWC compilation of 181 sightings from the central and northern Great Barrier Reef indicated that dwarf minke whales were regularly seen between Cairns (16°55' S) and Yonge Reef (14° 36' S). Sightings occurred from May to September, with 79.5% of sightings in June and July. Observations suggest, however, that groups of animals may occur in open water on the continental shelf, inshore of the reefs where most whales have been reported. Records of stranded animals 3 m or less in length indicate calving can occur at about 24E-38E S in Australia. There were four reports of cow-calf pairs on the northern Great Barrier Reef, between 15°-16°S, but more information is needed to assess the extent to which the area is a calving/nursery ground (Arnold, 1997).
- Humpback whales which migrate along the east Australian coast comprise part of the Area V (130° E - 170° W) stock. Sheltered water within the Great Barrier Reef between latitudes 16°-21° S appear to be an important breeding ground for the east Australian humpback whale stock (Paterson & Paterson, 1984).
- The humpback whales present in the marine park generally spend the summer feeding in the nutrient-rich waters of Antarctica, migrate northwards in the autumn, and winter in warm-water breeding areas, including the waters off the coast of Queensland. Humpbacks are usually present in the Marine Park from June to October. Of particular concern in the Marine Park are possible adverse effects on pregnant females and cows with young calves. Lactating females typically migrate north before pregnant females, and cows with newborn calves tend to be last to leave the breeding areas to return south to the feeding grounds. Thus, cows who are pregnant or who have young (dependent) calves are present in the Marine Park throughout the season (GBRMP, 2000).

Number of Supporting Documents[131]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	0	0	1	0

[131] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	0 - Not Applicable	0 - Not Applicable
Breeding / Calving	3 - Eligible	3 - Eligible
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Bonney Upwelling (Australia)

Potential Criterion:	2B: Foraging Area
Species of Concern:	Blue whale (*Balaenoptera musculus*) Pygmy blue whale (*B. m. brevicauda*) New Zealand fur seal (*Arctocephalus forsteri*) Southern right whale (Eubalaena australis) Australian sea lion (*Neophoca cinera*)
Proposed Boundary Consideration: Location inferred from Gill (2002)	139°31'17.703"E, 37°12'20.036"S to 139°42'42.508"E, 37°37'33.815"S to 140°22'57.345"E, 38°10'36.144"S to 141°33'50.342"E, 38°44'50.558"S to 141°11'0.733"E, 39°7'4.125"S to 139°10'52.263"E, 37°28'33.179"S
Proposed Seasonal Consideration:	November through May

- **Background**
- The Bonney Upwelling (formerly the Blue Whale aggregation) is characterized by classical upwelling plumes regularly observed along the Bonney Coast (Robe, South Australia to Portland, Victoria).
- To assess how seasonal changes in ocean productivity influenced foraging behavior, one study fitted18 lactating New Zealand fur seals with satellite transmitters and time-depth recorders (TDRs). Using temperature and depth data from TDRs, they used the presence of thermoclines as a surrogate measure of upwelling activity in continental- shelf waters. The study concluded that lactating New Zealand fur seals shift their foraging location from continental-shelf to oceanic waters in response to a seasonal decline in productivity over the continental shelf, attributed to the cessation of the Bonney upwelling (Baylis, Page, & Goldsworthy, 2008).
- A localized aggregation of blue whales, which may be pygmy blue whales, occurs in southern Australian coastal waters (between 139°45' E-143°E) during summer and autumn (December-May), where they feed on coastal krill (*Nyctiphanes australis*), a species which often forms surface swarms. While the abundance of blue whales using this area is unknown, up to 32 blue whales have been sighted in individual aerial surveys. Krill appear to aggregate in response to enhanced productivity resulting from the summer-autumn wind-forced Bonney Coast upwelling along the continental shelf. During the upwelling's quiescent (winter-spring) period, blue whales appear to be absent from the region. Krill surface swarms have been associated with 48% of 261 blue whale sightings since 1998, with direct evidence of feeding observed in 36% of all sightings. Mean blue whale group size was 1.55 (SD = 0.839), with all size classes represented including claves. This seasonally predictable upwelling system is evidently a regular feeding ground for blue whales (Gill, 2002).
- http://bluewhalestudy.com/home.html

Number of Supporting Documents[132]

Peer-Reviewed Articles	Scientific Committee Reports	Cruise Reports or Transects	Pers Comm. or Unpublished Report	Dissertation or Thesis	Book , Govt Report or NGO Report	Note/ Abstracts / Proceedings
2	0	0	1	0	0	0

[132] Eligibility for all species based on supporting documents. Eligibility for LF specialists only is broken out in the table.

NMFS' Classification Scores for Supporting Documents

	Preliminary Classification Rank	Rank for LF Hearing Specialists
High Density	0 - Not Applicable	0 - Not Applicable
Foraging Area	3 - Eligible	3 - Eligible
Breeding / Calving	0 - Not Applicable	0 - Not Applicable
Migration Route	0 - Not Applicable	0 - Not Applicable
Critical Habitat	0 - Not Applicable	0 - Not Applicable
Small Distinct Population	0 - Not Applicable	0 - Not Applicable

NMFS' Classification Scores for the Boundary Consideration

Rank	Description
2	Proposed boundary inferred from analyses conducted for purposes other than quantifying a core area of biological significance. Designation inferred from habitat suitability models (non-peer reviewed), expert opinion, regional expertise, or gray literature.

Works Cited

Abend, A. (1993). *Distribution and diet of long-finned pilot whales as determined from stable carbon and nitrogen ratio isotope tracers.* University of Massachusetts, Amherst, MA.

Abend, A., & Smith, T. (1999). Review of Distribution of the Long-finned Pilot Whale (Globicephala melas) in the North Atlantic and Mediterranean.

Acevedo-Gutiérrez, A., & Smultea, M. (1995). First records of humpback whales including calves at Golfo Dulce and Isla del Coco, Costa Rica, suggesting geographical overlap of Northern and Southern hemisphere populations. *Marine Mammal Science.*, *11*(4), 554-560.

Anon. (2005). *Report of the Workshop on Finless Porpoises in theWestern North Pacific. (Available from IWC, The Red House, 135 Station Road, Impington, Cambridge C24 9NP, UK.).*

Anon. (2010). *Progress report on the Med09 cruise. ACCOBAMS, 6th Meeting of the Scientific Committee, Casablanca, 11-13 January 2010. Document SC6-Inf 06. 21 p.*

Arcangeli, A., Muzi, E., Tepsich, P., Carcassi, S., Castelli, A., Crosti, R., et al. (2009). *Large-scale cetacean monitoring from passenger ferries in Italy: networking summer 2008 surveys. Proceedings of the 23rd Conference of the European Cetacean Society, Istanbul. 6 p.*

Arnold, P. (1997). *Occurrence of dwarf minke whales (Balaenoptera acutorostrata) on the northern Great Barrier Reef, Australia*.

Azzellino, A., Gaspari, S., Airoldi, S., & Nani, B. (2008). Habitat use and preferences of cetaceans along the continental slope and the adjacent pelagic waters in the western Ligurian Sea. *Deep-Sea Research Part I: Oceanographic Research Papers*, *55*(3), 296-323.

Baraff, L., Clapham, P., Mattila, D., & Bowman, R. (1991). Feeding behavior of a humpback whale in low-latitude waters. *Marine Mammal Science*, *7*(2), 197-202.

Barlow, J., & Forney, K. (2007). Abundance and population density of cetaceans in the California Current ecosystem. *FISHERY BULLETIN-NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION*, *105*(4), 509.

Baumgartner, M., Cole, T., Clapham, P., & Mate, B. (2003). North Atlantic right whale habitat in the lower Bay of Fundy and on the SW Scotian Shelf during 1999-2001. *Marine Ecology Progress Series*, *264*, 137-154.

Baylis, A., Page, B., & Goldsworthy, S. (2008). Effect of seasonal changes in upwelling activity on the foraging locations of a wide-ranging central-place forager, the New Zealand fur seal. *Canadian Journal of Zoology*, *86*(8), 774-789.

Bearzi, G., Costa, M., Politi, E., Agazzi, S., Pierantonio, N., Tonini, D., et al. (2009). Cetacean records and encounter rates in the Northern Adriatic Sea during the years 1988-2007. *Annales*, *19*(2), 145-150.

Beasley, I., Davidson, P., Somany, P., & Ath, L. (2002). *Abundance, distribution and conservation management of marine mammals in Cambodia's coastal waters. Unpublished report.*

Beier, E., & Ripa, P. (1999). Seasonal gyres in the northern Gulf of California. *Journal of Physical Oceanography*, *29*(2), 305-311.

Ben Naceur, L., Gannier, A., Bradai, M. N., Drouot, V., Bourreau, S., Laran, S., et al. (2004). Recensement du grand dauphin Tursiops truncatus dans les eaux tunisiennes. *Bull. Inst. Natn. Scien. Tech. Mer de Salammbô, 31*.

Best, P. (2001). Distribution and population separation of Bryde's whale Balaenoptera edeni off southern Africa. *Marine Ecology Progress Series, 220*, 277-289.

Best, P. (2007). *Whales and dolphins of the southern African subregion*: Cambridge University Press.

Best, P., Findlay, K., Sekiguchi, K., Peddemors, V., Rakotonirina, B., Rossouw, A., et al. (1998). Winter distribution and possible migration routes of humpback whales Megaptera novaeangliae in the southwest Indian Ocean. *MEPS, 162*, 287-299.

Best, P., Glass, J., Ryan, P., & Dalebout, M. (2009). Cetacean records from Tristan da Cunha, South Atlantic. *Journal of the Marine Biological Association of the UK, 89*(Special Issue 05), 1023-1032.

Best, P., Rademeyer, R., Burton, C., Ljungblad, D., Sekiguchi, K., Shimada, H., et al. (2003). The abundance of blue whales on the Madagascar Plateau, December 1996. *Journal of Cetacean Research and Management, 5*(3), 253-260.

Bordino, P., Albareda, D., & Fidalgo, G. (2004). *Abundance estimation of Franciscana dolphin Pontoporia blainvillei from boat surveys in Buenos Aires, Argentina. International Whaling Commission, Cambridge, UK, Scientific Committee Document SC/56/SM13.*

Bordino, P., Kraus, S., Albareda, D., Fazio, A., Palmerio, A., Mendez, M., et al. (2002). Reducing incidental mortality of Franciscana dolphin *Pontoporia blainvillei* with acoustic warning devices attached to fishing nets. *Marine Mammal Science, 18*(4), 833-842.

Bordino, P., & Wells, R. (2005). *Radiotracking of Franciscana Dolphins (Pontoporia Blainvillei) in Bahia Samborombon, Buenos Aires, Argentina.* Paper presented at the 16th Biennial Conference on the Biology of Marine Mammals, San Diego, California (USA), 12-16 Dec 2005.

Bordino, P., Wells, R., & Stamper, M. (2008). *Satellite tracking of Franciscana Dolphins Pontoporia blainvillei in Argentina: preliminary information on ranging, diving and social patterns. Paper SC/53/IA32 presented to the IWC Scientific Committee, (unpublished)*.

Branch, T., Stafford, K., Palacios, D., Allison, C., Bannister, J., Burton, C., et al. (2007). Past and present distribution, densities and movements of blue whales Balaenoptera musculus in the Southern Hemisphere and northern Indian Ocean. *Mammal Review, 37*(2), 116-175.

Brownell, R., & Ralls, K. (2008). Cetacean records from U. S. Commonwealth and Territories in the Pacific Ocean. PSRG-2008-15.

Brownell, R., Yamada, T., Mead, J., & Allen, B. (2006). *Mass strandings of melon-headed whales, Peponocephala electra: a worldwide review. SC/58/SM 8, 12 pp. (Available from IWC, The Red House, 135 Station Road, Impington, Cambridge C24 9NP, UK.)*.

Brownell, R., Yamada, T., Mead, J., & Van Helden, A. (2004). Mass strandings of Cuvier’s beaked whales in Japan: US Naval acoustic link. *Unpublished paper SC/56/ E, 37*.

Brownell, R., Yao, C., Lee, C., Wang, M., Yang, W., & Chou, L. (2009). Worldwide review of pygmy killer whales, Feresa attenuata, Mass Strandings Reveals Taiwan Hot Spot. *SC/61/SM1, 20 pp. (Available from IWC, The Red House, 135 Station Road, Impington, Cambridge C24 9NP, UK.)*.

Buckland, S., Anderson, D., Burnham, K., & Laake, J. (1993). *Distance sampling: Estimating abundance of biological populations*: Chapman & Hall London.

Buckland, S., Cattanach, K., & Miyashita, T. (1992). *Minke whale abundance in the northwest Pacific and the Okhotsk Sea, estimated from 1989 and 1990 sighting surveys*.

Burtenshaw, J. C., Oleson, E. M., Hildebrand, J. A., McDonald, M. A., Andrew, R. K., Howe, B. M., et al. (2004). Acoustic and satellite remote sensing of blue whale seasonality and habitat in the Northeast Pacific. *Deep Sea Research (Part II, Topical Studies in Oceanography), 51*(10-11), 967-986.

Böhm, E., Hopkins, T. S., Pietrafesa, L. J., & Churchill, J. H. Continental slope sea level and flow variability induced by lateral movements of the Gulf Stream in the Middle Atlantic Bight. *Progress In Oceanography, 70*(2-4), 196-212.

Böhm, E., Hopkins, T. S., Pietrafesa, L. J., & Churchill, J. H. (2006). Continental slope sea level and flow variability induced by lateral movements of the Gulf Stream in the Middle Atlantic Bight. *Progress In Oceanography, 70*(2-4), 196-212.

Calambokidis, J., Steiger, G., Cubbage, J., Balcomb, K., Ewald, C., Kruse, S., et al. (1990). *Sightings and movements of blue whales off central California 1986-88 from photo-identification of individuals*.

Calambokidis, J., Steiger, G., Ellifrit, D., Troutman, B., & Bowlby, C. (2004). Distribution and abundance of humpback whales(Megaptera novaeangliae) and other marine mammals off the northern Washington coast. *Fishery Bulletin, 102*(4), 563-580.

Campagna, C., Fedak, M., & McConnell, B. (1999). Post-breeding distribution and diving behavior of adult male southern elephant seals from Patagonia. *Journal of Mammalogy, 80*(4), 1341-1352.

Campagna, C., Le Boeuf, B., Blackwell, S., Crocker, D., & Quintana, F. (1995). Diving behaviour and foraging location of female southern elephant seals from Patagonia. *Journal of Zoology, 236*(1), 55-71.

Campagna, C., & Lewis, M. (1992). Growth and distribution of a southern elephant seal colony. *Marine Mammal Science, 8*(4), 387-396.

Campagna, C., Piola, A., Marin, M., Lewis, M., Zajaczkovski, U., & Fernández, T. (2007). Deep divers in shallow seas: Southern elephant seals on the Patagonian shelf. *Deep Sea Research Part I: Oceanographic Research Papers, 54*(10), 1792-1814.

Campagna, C., Piola, A., Rosa Marin, M., Lewis, M., & Fernández, T. (2006). Southern elephant seal trajectories, fronts and eddies in the Brazil/Malvinas Confluence. *Deep-Sea Research Part I, 53*(12), 1907-1924.

Campagna, C., Quintana, F., Le Boeuf, B., Blackwell, S., & Crocker, D. (1998). Diving behaviour and foraging ecology of female southern elephant seals from Patagonia. *Aquatic Mammals, 24*, 1-12.

Campagna, C., Rivas, A., & Marin, M. (2000). Temperature and depth profiles recorded during dives of elephant seals reflect distinct ocean environments. *Journal of Marine Systems, 24*(3-4), 299-312.

Carretta, J. V., Forney, K. A., Lowry, M. S., Barlow, J., Baker, J., Hanson, B., et al. (2008). *U.S. Pacific Marine Mammal Stock Assessments: 2008* (Report No. NOAA-TM-NMFS-SWFSC-434).

Carrillo, L., & Palacios-Hernandez, E. (2002). Seasonal evolution of the geostrophic circulation in the northern Gulf of California. *Estuarine, Coastal and Shelf Science, 54*(2), 157-173.

Cañadas, A., & Hammond, P. (2008). Abundance and habitat preferences of the short-beaked common dolphin Delphinus delphis in the southwestern Mediterranean: implications for conservation. *Endangered Species Research, 4*(3), 309.

Cañadas, A., Sagarminaga, R., De Stephanis, R., Urquiola, E., & Hammond, P. (2005). Habitat preference modelling as a conservation tool: proposals for marine protected areas for cetaceans in southern Spanish waters. *Aquatic Conservation: Marine and Freshwater Ecosystems, 15*(5), 495-521.

Cerchio, S., Andrianarivelo, N., Razafindrakoto, Y., Mendez, M., & Rosenbaum, H. (2009). *Coastal dolphin hunting in the southwest of Madagascar: status of populations, human impacts and conservation actions. In: Paper SC/61/SM15 presented to the IWC Scientific Committee, May 2009. 9pp.*

Cerchio, S., Ersts, P., Pomilla, C., Loo, J., Razafindrakoto, Y., Leslie, M., et al. (2009). *Updated estimates of abundance for humpback whale breeding stock C3 off Madagascar, 2000-2006. In: Paper SC/61/SH7 presented to the IWC Scientific Committee, May 2009 (unpublished). 23pp.*

Churchill, J., Levine, E., Connors, D., & Cornillon, P. (1993). Mixing of shelf, slope and Gulf Stream water over the continental slope of the Middle Atlantic Bight. *Deep Sea Research Part I: Oceanographic Research Papers, 40*(5), 1063-1085.

CIRVA. (1997). *Comite Internacional Para la Recuperacion de la Vaquita/International Committee for the Recovery of the Vaquita. Scientific Reports of: First Meeting, 25-26 January 1997.*

CIRVA. (1999). *Comite Internacional Para la Recuperacion de la Vaquita/International Committee for the Recovery of the Vaquita. Scientific Reports of the Second Meeting,7-11 February 1999.*

CIRVA. (2004). *Comite Internacional Para la Recuperacion de la Vaquita/International Committee for the Recovery of the Vaquita. Scientific Reports of the Third Meeting, 18-24 January 2004.*

Clapham, P., & Mattila, D. (1990). Humpback whale songs as indicators of migration routes. *Marine Mammal Science, 6*(2), 155-160.

Clapham, P., & Mattila, D. (1993). Reactions of humpback whales to skin biopsy sampling on a West Indies breeding ground. *Marine Mammal Science, 9*(4), 382-391.

Collins, T., Cerchio, S., Pomilla, C., Carvalho, I., Ngouessono, S., & Rosenbaum, H. (2008). Revised estimates of abundance for humpback whale breeding stock B1: Gabon. In: Paper SC/60/SH28 presented to the IWC Scientific Committee, May 2008 (unpublished). 17pp.

Collins, T., Ngouessono, S., & Rosenbaum, H. (2004). *A note on recent surveys for Atlantic humpback dolphins, Sousa teuszii (Kukenthal, 1892) in the coastal waters of Gabon*.

Craig, A., & Herman, L. (2000). Habitat preferences of female humpback whales Megaptera novaeangliae in the Hawaiian Islands are associated with reproductive status. *Marine Ecology Progress Series, 193*, 209-216.

Crespo, E., Pedraza, S., Grandi, M., Dans, S., & Garaffo, G. (2004). *Abundance of franciscana dolphins, Pontoporia blainvillei, in the argentine coast, from aerial surveys. SC/56/SM9 Working paper submitted to the meeting of the International Whaling Commission, Sorrento, Italy, 29/6 to 10/7/04.*

Crespo, E., Pedraza, S., Grandi, M., Dans, S., & Garaffo, G. (2010). Abundance and distribution of endangered Franciscana dolphins in Argentine waters and conservation implications. *Marine Mammal Science, 26*(1), 17-35.

Croll, D. A., Marinovic, B., Benson, S., Chavez, F. P., Black, N., Ternullo, R., et al. (2005). From wind to whales: trophic links in a coastal upwelling system. *Marine Ecology Progress Series, 289*, 117-130.

D' Amico, A., Bergamasco, A., Zanasca, P., Carniel, S., Nacini, E., Portunato, N., et al. (2003). Qualitative correlation of marine mammals with physical and biological parameters in the Ligurian Sea. *IEEE Journal of Oceanic Engineering, 28*(1), 29-43.

Danilewicz, D., Tavares, M., Moreno, I., Ott, P., & Trigo, C. (2009). Evidence of feeding by the humpback whale (Megaptera novaeangliae) in mid-latitude waters of the western South Atlantic. *Marine Biodiversity Records, 2*, e88.

De Forest, L., & Drazen, J. (2009). The influence of a Hawaiian seamount on mesopelagic micronekton. *Deep Sea Research Part I: Oceanographic Research Papers, 56*(2), 232-250.

DFO. (2007). *Recovery Potential Assessment Of Northern Bottlenose Whale, Scotian Shelf Population. Science Advisory Report 2007/011*.

Dolar, M. (1999). *Abundance, distribution and feeding ecology of small cetaceans in the eastern Sulu Sea and Tañon Strait, Philippines.* University of California, San Diego.

Dolar, M., Perrin, W., Taylor, B., Kooyman, G., & Alava, M. (2006). Abundance and distributional ecology of cetaceans in the central Philippines. *Journal of Cetacean Research and Management, 8*(1), 93.

DON. (2007a). *Navy OPAREA density estimates (NODE) for the Northeast OPAREAS: Boston, Narragansett Bay, and Atlantic. Naval Facilities Engineering Command, Atlantic; Norfolk, Virginia. Contract N62470-02-D-9997, Task Order 0045. Prepared by Geo-Marine, Inc., Plano, Texas*.

DON. (2007b). *Navy OPAREA Density Estimates (NODE) for the Southeast OPAREAS: VACAPES, CHPT, JAX/CHASN, and Southeastern Florida & AUTEC-Andros, Prepared for U.S. Fleet Forces Command, Norfolk, VA.*

Durbin, E., Campbell, R., Casas, M., Ohman, M., Niehoff, B., Runge, J., et al. (2003). Interannual variation in phytoplankton blooms and zooplankton productivity and abundance in the Gulf of Maine during winter. *Marine Ecology Progress Series, 254*, 81-100.

Ersts, P., & Rosenbaum, H. (2003). Habitat preference reflects social organization of humpback whales (Megaptera novaeangliae) on a wintering ground. *Journal of Zoology, 260*(04), 337-345.

Falabella, V., Campagna, C., & Croxall, J. (2009). *Atlas del Mar Patagónico Especies y espacios, Wildlife Conservation Society Argentina. WCS*: Cambridge: BirdLife International.

Ferguson, M., & Barlow, J. (2001). *Spatial distribution and density of cetaceans in the eastern tropical Pacific Ocean based on summer/fall research vessel surveys in 1986-96. Admin. Rept*: LJ-01-04 available from the Southwest Fisheries Science Center, 8604 La Jolla Shores Dr., La Jolla, CA 92037. 61pp.+ Addendum.

Ferguson, M., & Barlow, J. (2003). *Addendum: Spatial distribution and density of cetaceans in the eastern tropical Pacific Ocean based on summer/fall research vessel surveys in 1986-96*: Administrative Report LJ-01-04 (addendum), Southwest Fisheries Science Center, National Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037.

Ferguson, M., Barlow, J., Fiedler, P., Reilly, S., & Gerrodette, T. (2006). Spatial models of delphinid (family Delphinidae) encounter rate and group size in the eastern tropical Pacific Ocean. *Ecological Modelling, 193*(3-4), 645-662.

Ferguson, M., Barlow, J., Reilly, S., & Gerrodette, T. (2006). Predicting Cuvier's (Ziphius cavirostris) and Mesoplodon beaked whale population density from habitat characteristics in the eastern tropical Pacific Ocean. *Journal of Cetacean Research and Management, 7*(3), 287.

Fiedler, P., Reilly, S., Hewitt, R., Demer, D., Philbrick, V., Smith, S., et al. (1998). Blue whale habitat and prey in the California Channel Islands. *Deep-Sea Research Part II, 45*(8-9), 1781-1801.

Findlay, K. (2001). A review of humpback whale catches by modern whaling operations in the Southern Hemisphere. *MEMOIRS-QUEENSLAND MUSEUM, 47*(2), 411-420.

Forcada, J., Aguilar, A., Hammond, P., Pastor, X., & Aguilar, R. (2006). Distribution and numbers of striped dolphins in the western Mediterranean Sea after the 1990 epizootic outbreak. *Marine Mammal Science, 10*(2), 137-150.

Forcada, J., Gazo, M., Aguilar, A., Gonzalvo, J., & Fernández-Contreras, M. (2004). Bottlenose dolphin abundance in the NW Mediterranean: addressing heterogeneity in distribution. *Marine Ecology Progress Series, 275*, 275-287.

Forcada, J., Notarbartolo di Sciara, G., & Fabbri, F. (1995). Abundance of fin whales and striped dolphins summering in the Corso-Ligurian Basin. *Mammalia, 59*(1), 127-140.

Forney, K. (2007). Preliminary estimates of cetacean abundance along the US west coast and within four National Marine Sanctuaries during 2005. US Department of Commerce. *NOAA Technical Memorandum NMFS-SWFSC-406. 27p*.

Frantzis, A., Swift, R., Gillespie, D., Menhennett, C., Gordon, J., & Gialinakis, S. (1999). Sperm whale presence off south-west Crete, Greece, eastern Mediterranean. *Eur Res Cet, 13*, 214-217.

Fujino, K. (1960). Immunogenetic and marking approaches to identifying sub-populations of the North Pacific whales. *Sci. Rep. Whales Res. Inst., Tokyo, 15*, 84-142.

Gabriele, C., Rickards, S., Yin, S., & Frankel, A. (2003). *Trends in Relative Distribution, Abundance and Population Composition of Humpback Whales, Megaptera novaeangliae, in Kawaihae Bay, Hawai'i 1988-2003. Final Report August 2003 for the Department of Land and Natural Resources, State of Hawai'I and the Hawaiian Islands Humpback Whale National Marine Sanctuary, National Marine Sanctuary Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.*

Gannon, D., Craddock, J., & Read, A. (1998). Autumn food habits of harbor porpoises, Phocoena phocoena, in the Gulf of Maine. *Fishery Bulletin, 96*(3), 428-437.

Garrison, L., Martinez, A., & Maze-Foley, K. ((in review)). Habitat and abundance of marine mammals in continental slope waters of the Southeastern U.S. Atlantic.

Garrison, L., Swartz, S., Martinez, A., Burks, C., Stamates, J., & Fisheries, N. (2003). A marine mammal assessment survey of the southeast US continental shelf: February-April 2002. *NOAA Technical Memorandum NMFS-SEFSC-492. US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center*.

GBRMP. (2000). Whale and dolphin conservation in the Great Barrier Reef Marine Park: policy document. *B. a. WHG Species Conservation Team & Conservation, ed. Great Barrier Reef Marine Park Authority*, 69.

Genov, T., Kotnjek, P., Lesjak, J., Hace, A., & Fortuna, C. (2008). *Bottlenose dolphins (Tursiops truncatus) in Slovenian and adjacent waters (northern Adriatic Sea)*.

Gill, P. (2002). A blue whale (Balaenoptera musculus) feeding ground in a southern Australian coastal upwelling zone. *J. Cetacean Res. Manage, 4*(2), 179-184.

Gilles, A., Herr, H., Lehnert, K., Scheidat, M., & Siebert, U. (2008). Harbour porpoises abundance estimates and seasonal distribution patterns. *Marine mammals and seabirds in front of offshore wind energy. Wiesbaden: BG Teuber Verlag/GWV Fachverlage GmbH*, 19-36.

GOJ. (2007). Government of Japan website for Dall's porpoise abundance estimates., from http://kokushi.job.affrc.go.jp/H20/H20_46.pdf

Gutiérrez, O., Marinone, S., & Parés-Sierra, A. (2004). Lagrangian surface circulation in the Gulf of California from a 3D numerical model. *Deep Sea Research Part II: Topical Studies in Oceanography, 51*(6-9), 659-672.

Gómez de Segura, A., Crespo, E., Pedraza, S., Hammond, P., & Raga, J. (2006). Abundance of small cetaceans in waters of the central Spanish Mediterranean. *Marine Biology, 150*(1), 149-160.

Haley, N., & Read, A. (1993). Summary of the workshop on harbor porpoise mortalities and human interaction. *NOAA Tech. Mem. NMFS-F/NER, 5*.

Hamazaki, T. (2002). Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic ocean(from Cape Hatteras, North Carolina, U. S. A. to Nova Scotia, Canada). *Marine Mammal Science, 18*(4), 920-939.

Hansen, L., Mullin, K., Jefferson, T., & Scott, G. (1996). Visual surveys aboard ships and aircraft. *Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report, 2*, 96-0027.

Hare, J., Churchill, J., Cowen, R., Berger, T., Cornillon, P., Dragos, P., et al. (2002). Routes and rates of larval fish transport from the southeast to the northeast United States continental shelf. *Limnology and Oceanography*, 1774-1789.

Hayano, A. e. a. (2004). *Life history and group composition of melon-headed whales based on mass strandings on the Japanese coast. In: the Seventeenth Biennial Conference on the Biology of Marine Mammals, Abstract, Society for Marine Mammalogy, Cape Town, South Africa.* Paper presented at the Seventeenth Biennial Conference on the Biology of Marine Mammals.

Hayano, A. e. a. (2007). *Life history and group composition of melon-headed whales based on mass strandings on the Japanese coast. In: the Seventeenth Biennial Conference on the Biology of*

Marine Mammals, Abstract, Society for Marine Mammalogy, Cape Town, South Africa. Paper presented at the Seventeenth Biennial Conference on the Biology of Marine Mammals.

Heimlich-Boran, J. R. (1993). *Social organization of the short-finned pilot whale, Globicephala macrorhynchus, with reference to the comparative social ecology of delphinids*. Cambridge University.

Holden, C. (2007). WHALE SENSING. *Science, 315*(5816), 1199d.

Hooker, S., Iverson, S., Ostrom, P., & Smith, S. (2001). Diet of northern bottlenose whales inferred from fatty-acid and stable-isotope analyses of biopsy samples. *Canadian Journal of Zoology, 79*(8), 1442-1454.

Hooker, S., Whitehead, H., & Gowans, S. (2002). Ecosystem consideration in conservation planning: energy demand of foraging bottlenose whales (Hyperoodon ampullatus) in a marine protected area. *Biological Conservation, 104*(1), 51-58.

Ichihara, T. (1957a). An application of linear discriminant function to external measurements of fin whale. *Scient. Rep. Whales Res. Inst., Tokyo, 12*, 127—189.

Ichihara, T. (1957b). An application of linear discriminant function to external measurements of fin whale. *Scient. Rep. Whales Res. Inst., Tokyo, 12*, 127—189.

IMO. (2007). *International Maritime Organization, Routing measures other than Traffic Separation Schemes. Ref. T2-OSS/2.7, SN.1/Circ.263,*.

Jaramillo-Legorreta, A., & Rojas-Bracho, L. (2008). *Passive acoustic assesment of vaquita. Paper SC/60/SM3 presented to the IWC Scientific Committee, 2008 (unpublished). 8pp.*

Jaramillo-Legorreta, A., Rojas-Bracho, L., Brownell, R., Read, A., Reeves, R., Ralls, K., et al. (2007). Saving the vaquita: immediate action, not more data. *Conservation Biology, 21*(6), 1653-1655.

Jaramillo-Legorreta, A., Rojas-Bracho, L., & Gerrodette, T. (1999). A new abundance estimate for vaquitas: first step for recovery. *Marine Mammal Science, 15*(4), 957-973.

Jefferson, T., Hung, S., Law, L., Torey, M., & Tregenza, N. (2002). Distribution and abundance of finless porpoises in Hong Kong and adjacent waters of China. *Raffles Bulletin of Zoology, 50*, 43-56.

Johnson, M., Madsen, P., Zimmer, W., De Soto, N., & Tyack, P. (2004). Beaked whales echolocate on prey. *Proceedings of the Royal Society of London. Series B: Biological Sciences, 271*(Suppl 6), S383.

Johnson, S., Richardson, W., Yazvenko, S., Blokhin, S., Gailey, G., Jenkerson, M., et al. (2007). A western gray whale mitigation and monitoring program for a 3-D seismic survey, Sakhalin Island, Russia. *Environmental Monitoring and Assessment, 134*(1), 1-19.

Johnston, D., McDonald, M., Polovina, J., Domokos, R., Wiggins, S., & Hildebrand, J. (2008). Temporal patterns in the acoustic signals of beaked whales at Cross Seamount. *Biology Letters, 4*(2), 208.

Johnston, D., Westgate, A., & Read, A. (2005). Effects of fine-scale oceanographic features on the distribution and movements of harbour porpoises Phocoena phocoena in the Bay of Fundy. *Marine Ecology Progress Series, 295*, 279-293.

Kahn, B. (2001). Komodo National Park cetacean surveys: A rapid ecological assessment of cetacean diversity, abundance, and distribution. Interim report - October 2001.

Kahn, B., Wawandono, N., & Subijanto, J. (2001). Positive identification of the rare pygmy Bryde's whale (*Balaenoptera edeni*) with the assistance of genetic profiling. Unpublished Unpublished contract report.

Kasuya, T., & Miyashita, T. (1988). Distribution of sperm whale stocks in the North Pacific. *Scientific Reports of the Whales Research Institute (Tokyo), 39*, 31-75.

Kasuya, T., & Miyashita, T. (1997). Distribution of Baird's beaked whales off Japan. *Report of the International Whaling Commission, 47*, 963–968.

Kasuya, T., Miyashita, T., & Kasamatsu, F. (1988). Segregation of two forms of short-finned pilot whales off the Pacific coast of Japan. *Sci. Rep. Whales Res. Inst, 39*, 77-90.

Kasuya, T., & Tai, S. (1993). Life history of short-finned pilot whale stocks off Japan and a description of the fishery. *Report of the International Whaling Commission*, 439-473.

Kato, H. (1992). *Body length, reproduction and stock separation of minke whales off northern Japan*.

Keller, C., Ward-Geiger, L., Brooks, W., Slay, C., Taylor, C., & Zoodsma, B. (2006). North Atlantic right whale distribution in relation to sea-surface temperature in the southeastern United States calving grounds. *Marine Mammal Science, 22*(2), 426.

Kenney, R., Winn, H., & Macaulay, M. (1995). Cetaceans in the Great South Channel, 1979-1989: right whale (Eubalaena glacialis). *Continental Shelf Research, 15*(4-5), 385-414.

Kenney, R., & Wishner, K. (1995). The South Channel Ocean Productivity EXperiment. *Continental Shelf Research, 15*(4-5), 373-384.

Kiszka, J., Berggren, P., Rosenbaum, H., Cerchio, S., Rowat, D., Drouot-Dulau, V., et al. (2009). *Cetaceans in the southwest Indian Ocean: a review of diversity, distribution and conservation issues. Paper SC/61/O18 presented to the IWC Scientific Committee, May 2009 (unpublished). 12pp.*

Koopman, H. (1998). Topographical distribution of the blubber of harbor porpoises (Phocoena phocoena). *Journal of Mammalogy, 79*(1), 260-270.

Kraus, S., Hamilton, P., Kenney, R., Knowlton, A., & Slay, C. (2001). Reproductive parameters of the North Atlantic right whale. *Journal of Cetacean Research and Management, 2*, 231-236.

Lasta, C. (1995). La Bahía Samborombón: zona de desove y cría de peces.

Lasta, C., & Acha, E. (1996). Cabo San Antonio: su importancia en el patrón reproductivo de peces marinos.[Cape San Antonio: its importance for reproductive pattern of marine fishes]. *Frente Marítimo, 16*, 39-45.

Leatherwood, S., Caldwell, D., Winn, H., Schevill, W., & Caldwell, M. (1976). Whales, dolphins, and porpoises of the western North Atlantic: a guide to their identification. from http://aquacomm.fcla.edu/1417/2/NOAA_Tech_Rpt_NMFS_CIRC-396.pdf

Lewis, T. (2010). *Preliminary abundance estimate of sperm whales in the SW Mediterranean from an acoustic line-transect survey. ACCOBAMS, 6th Meeting of the Scientific Committee, Casablanca, 11-13 January 2010. Document SC6-Inf 13. 8 p.*: ACCOBAMS.

Link, J., Overholtz, W., O'Reilly, J., Green, J., Dow, D., Palka, D., et al. (2008). The Northeast U.S. continental shelf Energy Modeling and Analysis exercise (EMAX): Ecological network model development and basic ecosystem metrics. *Journal of Marine Systems*, *74*(1-2), 453-474.

Lázaro, M., Lessa, E., & Hamilton, H. (2004). Geographic genetic structure in the franciscana dolphin (Pontoporia blainvillei). *Marine Mammal Science, 20*(2), 201-214.

MacLeod, C., & Mitchell, G. (2005). Key areas for beaked whales worldwide. *Journal of Cetacean Research and Management, 7*(3), 309.

Mahabub, E. (2008). *Minimum population size of Bryde's whale (Balaenoptera edeni) estimated using photo-identification techniques in the Swatch-of-No-Ground, Bangladesh, during winter seasons 2005-2008. Senior thesis project,.* Independent University, Bangladesh.

Mahakunlayanakul, S. (1996). *Species distribution and status of dolphins in the inner Gulf of Thailand. Ph.D. thesis, Chulalongkorn University, 130 pp.*

Mate, B. R., Gisiner, R., & Mobley, J. (1998). Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. *Canadian Journal of Zoology/Revue Canadien de Zoologie, 76*(5), 863-868.

Mattila, D., Clapham, P., Katona, S., & Stone, G. (1989). Population composition of humpback whales, Megaptera novaeangliae, on Silver Bank, 1984. *Canadian Journal of Zoology*, *67*(2), 281-285.

McDonald, M., Mesnick, S., & Hildebrand, J. (2006). Biogeographic characterization of blue whale song worldwide: using song to identify populations. *Journal of Cetacean Research and Management, 8*(1).

Meier, S., Yazvenko, S., Blokhin, S., Wainwright, P., Maminov, M., Yakovlev, Y., et al. (2007). Distribution and abundance of western gray whales off northeastern Sakhalin Island, Russia, 2001-2003. *Environmental monitoring and assessment*, *134*(1-3), 107.

Mendez, M., Rosenbaum, H., & Bordino, P. (2008). Conservation genetics of the franciscana dolphin in northern Argentina: population structure, by-catch impacts, and management implications. *Conservation Genetics*, *9*(2), 419-435.

Mendez, M., Rosenbaum, H., Yackulic, C., Subramaniam, A., & Bordino, P. (2010). Isolation by environmental distance in mobile marine species: molecular ecology of franciscana dolphins at their southern range. . *Molecular Ecology. In press.*

Merrick, R., & Cole, T. (2007). *Evaluation of northern right whale ship strike reduction measures in the Great South Channel of Massachusetts, NOAA Tech Memo NMFS NE 202*: National Oceanic and Atmospheric Administration.

Michels, K. H., Suckow, A., Breitzke, M., Kudrass, H. R., & Kottke, B. (2003). Sediment transport in the shelf canyon "Swatch of No Ground" (Bay of Bengal). *Deep Sea Research Part II: Topical Studies in Oceanography, 50*(5), 1003-1022.

Minoda, T. (1989). *Oceanographic and biomass changes in the Oyashio Current ecosystem in Kenneth Sherman and Lewis M. Alexander (eds.), Biomass Yields and Geography of Large Marine Ecosystems (Boulder: Westview) AAAS Selected Symposium 111.*

Miyashita, T. (1986). Abundance of Baird's beaked whales off the Pacific coast of Japan. *Rep. Int. Whal. Comm., 36*, 383-386.

Miyashita, T. (1993). *Abundance of dolphin stocks in the western North Pacific taken by the Japanese drive fishery*.

Miyashita, T. (2004). *Cruise report of the common minke whale sighting surveys in the Sea of Okhotsk in 2003*: Paper SC/56/RMP1, available from the International Whaling Commission, Cambridge, UK.

Miyashita, T., & Kato, H. (1993). Population estimate of Baird's beaked whales off the Pacific coast of Japan using sighting data collected by R/V SHUNYO MARU in 1991 and 1992. *IWC/SC/45/SM6*.

Miyashita, T., & Kato, H. (1998). *Recent data on the status of right whales in the NW Pacific Ocean*.

Miyazaki, N., & Amano, M. (1994). Skull morphology of two forms of short-finned pilot whales off the Pacific coast of Japan. *Rep. Int. Whaling Commn, 44*, 499-508.

Miyazaki, N., & Nakayama, K. (1989). Records of cetaceans in the waters of the Amami Islands. *Mem. Natn. Sci. Mus. Tokyo, 22*, 235-249.

Mobley, J., Bauer, G., & Herman, L. (1999). Changes over a ten-year interval in the distribution and relative abundance of humpback whales (Megaptera novaeangliae) wintering in Hawaiian waters. *Aquatic Mammals, 25*, 63-72.

Mobley, J., Spitz, S., Grotefendt, R., Forestell, P., Frankel, A., & Bauer, G. (2001). Abundance of humpback whales in Hawaiian waters: Results of 1993-2000 aerial surveys. *Report to the Hawaiian Islands Humpback Whale National Marine Sanctuary, 26*.

Mori, S. (2005). *Distribution and residency of Indo-Pacific bottlenose dolphins (Tursiops aduncus) in the waters of the Ogasawara (Bonnin) Islands, Japan. In: Sixteenth Biennial Conference on the Biology of Marine Mammals.* Paper presented at the Sixteenth Biennial Conference on the Biology of Marine Mammals, San Diego, CA.

Mullin, K., & Fulling, G. (2003). Abundance of cetatceans in the southern US North Atlantic Ocean during summer 1998. *FISHERY BULLETIN, 101*(3), 603-613.

Mullin, K., & Hoggard, W. (2000). Visual surveys of cetaceans and sea turtles from aircraft and ships. *Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations, 2*, 96-0027.

Mussi, B., Miragliuolo, A., & Bearzi, G. (2002). Short-beaked common dolphins around the island of Ischia, Italy (Southern Tyrrhenian Sea). *European Research on Cetaceans, 16*, 15.

Mustika, P. (2006). *Marine mammals in the Savu Sea (Indonesia): indigenous knowledge, threat analysis and management options.* James Cook University.

Nanbu, Y., Hirose, J., Kubo, N., Kishiro, T., & Shinomiya, A. (2006). Location and number of individuals of Indo-Pacific bottlenose dolphins (Tursiops aduncus) in Kagoshima Bay [Japan]. *Memoirs of Faculty of Fisheries-Kagoshima University (Japan)*.

NMFS. (1994). *Designated Critical Habitat; Northern Right Whale. 59 Federal Register 28793-28834, June 3, 1994*.

NMS. (2009a, March 26, 2008). Cordell Bank Sanctuary: Seamounts And Banks. Retrieved September 2009, from http://www.sanctuarysimon.org/cordell/sections/seamounts/overview.php?sec=sm

NMS. (2009c, March 26, 2008). Gulf of the Farrallones Sanctuary. Retrieved September 2009, from http://www.sanctuarysimon.org/farallones/index.php

Northridge, S. (1996). Seasonal distribution of harbour porpoises in US Atlantic waters. *REPORT-INTERNATIONAL WHALING COMMISSION, 46*, 613-618.

Northrop, J., Cummings, W., & Thompson, P. (1967). 20 Hz signals observed in the central Pacific. *The Journal of the Acoustical Society of America, 42*, 1211.

Notarbartolo di Sciara, G. (2010). Personal Communication. Tethys Research Institute. Milano, Italy.

Notarbartolo-Di-Sciara, G., Zanardelli, M., Jahoda, M., Panigada, S., & Airoldi. (2003). The fin whale Balaenoptera physalus (L. 1758) in the Mediterranean Sea. *Mammal Review, 33*(2), 105-150.

Notarbotolo di Sciara, G., Venturino, M., Zanardelli, M., Bearzi, G., Borsani, F., & Cavalloni, B. (1993). Cetaceans in the central Mediterranean Sea: distribution and sighting frequencies. *Italian Journal of Zoology, 60*(1), 131-138.

O'Hern, J., & Biggs, D. (2009). Sperm Whale (Physeter macrocephalus) Habitat in the Gulf of Mexico: Satellite Observed Ocean Color and Altimetry Applied to Small-Scale Variability in Distribution. *Aquatic Mammals, 35*(3), 358-366.

Oleson, E., Calambokidis, J., Barlow, J., & Hildebrand, J. B. W. V. A. A. E. R. I. T. S. C. B. (2007). Blue whale visual and acoustic encounter rates in the Southern California Bight. *Marine Mammal Science, 23*(3), 574-597.

Omura, H., & Sakiura, H. (1956). Studies on the little piked whale from the coast of Japan. *Sci. Rep. Whales Res. Inst. Tokyo, 11*, 1-37.

Overholtz, W., & Link, J. (2007). Consumption impacts by marine mammals, fish, and seabirds on the Gulf of Maine–Georges Bank Atlantic herring (Clupea harengus) complex during the years 1977–2002. *ICES Journal of Marine Science, 64*, 83-96.

Pace, R. M., & Merrick, R. L. (2008). *Northwest Atlantic ocean habitats important to the conservation of North Atlantic right whales (Eubalaena glacialis). US Dept Commerce, Northeast Fish Sci Cent Ref Doc 08-07*. Retrieved from http://www.nefsc.noaa.gov/publications/crd/crd0807/crd0807.pdf.

Palka, D. (1995). *Preliminary cruise report of the spring distribution survey of harbor porpoises in the Mid-Atlantic. Available at NOAA/NMFS/NEFSC, Woods Hole, MA 02543. 7pp.*

Palka, D. (2006). Summer abundance estimates of cetaceans in US North Atlantic navy operating areas. *US Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc*, 06-03.

Palka, D., Orphanides, C., & Warden, M. (2009). Summary of harbor porpoise (Phocoena phocoena) bycatch and levels of compliance in the northeast and mid-Atlantic gillnet fisheries after the implementation of the Take Reduction Plan: 1 January 1999-31 May 2007. *NOAA Technical Memorandum NMFS NE, 212*(89), 02543-01026.

Palka, D., Read, A., Westgate, A., & Johnston, D. (1996). *Summary of current knowledge of harbour porpoises in US and Canadian Atlantic waters. Rep. Int. Whal. Commn 46: 559-565.*

Panigada, S., & Azzellino, A. (2009). *Determinazione degli habitat critici delle specie di cetacei presenti nell'area del Santuario Pelagos (porzione occidentale), ai fini della gestione. Rapporto finale.* : Istituto Tethys.

Panigada, S., Burt, L., Lauriano, G., Pierantonio, N., & Donovan, G. (2009). Winter abundance of striped dolphins (Stenella coeruleoalba) in the Pelagos Sanctuary (north-western Mediterranean Sea) assessed through aerial survey. *Journal of Cetacean Research Management*(SC/61/SM7), 1-10.

Panigada, S., Notarbartolo di Sciara, G., Panigada, M., Airoldi, S., Borsani, J., & Jahoda, M. (2005). Fin whales (Balaenoptera physalus) summering in the Ligurian Sea: distribution, encounter rate, mean group size and relation to physiographic variables. *Journal of Cetacean Research Management, 7*(2), 137-145.

Paterson, R., & Paterson, P. (1984). A study of the past and present status of humpback whales in east Australian waters. *Biological Conservation, 29*(4), 321-343.

Payne, P., & Heinemann, D. (1993). The distribution of pilot whales (Globicephala spp.) in shelf/shelf-edge and slope waters of the Northeastern United States, 1978-1988 In: Biology of Northern Hemisphere Pilot Whales-Reports of the International Whaling Commission, Special issue 14. *IWC, Cambridge, UK*, 51-68.

Pegau, W., Boss, E., & Martínez, A. (2002). Ocean color observations of eddies during the summer in the Gulf of California. *Geophysical Research Letters, 29*(9), 9-1.

Perrin, W., Dolar, M., Amano, M., & Hayano, A. (2003). Cranial Sexual Dimorphism And Geographic Variation In Eraser's Dolphin, Lagenodelphis Hosei. *Marine Mammal Science, 19*(3), 484-501.

Perrin, W., & Hohn, A. (1994). Pan tropical spotted dolphin Stenella attenuata. *Handbook of marine mammals: The first book of dolphins*, 71.

Pet-Soede, L. (2002). *The Solor and Alor islands: Expedition results, data collected during 2 reconnaissance trips; 9-12 September 2001 and 7-19 May, 2002. Report of a joined activity by The Nature Conservancy Southeast Asia Center for Marine Protected Areas and World Wide Fund for Nature Wallacea Bioregional Program.*

Pomilla, C., & Rosenbaum, H. (2005). Against the current: an inter-oceanic whale migration event. *Biology Letters, 1*(4), 476.

Read, A. (1999). Harbour porpoise Phocoena phocoena (Linnaeus, 1758). *Handbook of marine mammals, 6*, 323-355.

Reeves, R., Mckenzie, M., & Smith, T. (2006). History of Bermuda shore whaling, mainly for humpback whales. *Journal of Cetacean Research and Management, 8*(1), 33.

Reilly, S., & Thayer, V. (1990). Blue Whale (Balaenoptera-Musculus) Distribution In The Eastern Tropical Pacific. *Marine Mammal Science, 6*(4), 265-277.

Rendell, L., Cañadas, A., & Mundy, C. (2005). *Scientific Report Balearics Sperm Whale Project 2003-2005*: The Nando Peretti Foundation, One World Wildlife.

Rice, D. (1998). Marine Mammals of the World: Systematics and Distribution, Special Publication Number 4, The Society for Marine Mammalogy: Allen Press, USA. ix+ 231pp.

Rojas-Bracho, L., & Taylor, B. (1999). Risk factors affecting the vaquita (Phocoena sinus). *Marine Mammal Science, 15*(4), 974-989.

Romero, S., Piola, A., Charo, M., & Garcia, C. (2006). Chlorophyll-a variability off Patagonia based on SeaWiFS data. *Journal of Geophysical Research, 111*(C5), C05021.

Rosa, S., Milinkovitch, M., Van Waerebeek, K., Berck, J., Oporto, J., Alfaro-Shigueto, J., et al. (2005). Population structure of nuclear and mitochondrial DNA variation among South American Burmeister's porpoises (Phocoena spinipinnis). *Conservation Genetics, 6*(3), 431-443.

Rosenbaum, H., & Collins, T. (2006). The Ecology, Population Characteristics and Conservation Efforts for Humpback Whales (Megaptera novaeangliae) on Their Wintering Grounds in the Coastal Waters of Gabon. *Bulletin of the Biological Society of Washington*, 425-433.

Rosenbaum, H., Pomilla, C., Mendez, M., Leslie, M., Best, P., Findlay, K., et al. (2009). Population Structure of Humpback Whales from Their Breeding Grounds in the South Atlantic and Indian Oceans.

Rosenbaum, H., Walsh, P., Razafindrakoto, Y., Vely, M., & Desalle, R. (1997). First description of a humpback whale wintering ground in Baie d'Antongil, Madagascar. *Conservation Biology, 11*(2), 308-314.

Rossman, M. (2009). Estimated Bycatch of Small Cetaceans in Northeast US Bottom Trawl Fishing Gear during 2000-2005. *J. Northw. Atl. Fish. Sci., 42*, 77-101.

Rugh, D., Shelden, K., & Schulman-Janiger, A. (2001). Timing of the southbound migration of gray whales. *J. Cetacean Res. Manage, 3*(1), 31-39.

Rutenko, A., Borisov, S., Gritsenko, A., & Jenkerson, M. (2007). Calibrating and monitoring the western gray whale mitigation zone and estimating acoustic transmission during a 3D seismic survey, Sakhalin Island, Russia. *Environmental Monitoring and Assessment, 134*(1), 21-44.

Saraceno, M., Provost, C., & Piola, A. (2005). On the relationship between satellite-retrieved surface temperature fronts and chlorophyll a in the western South Atlantic. *Journal of Geophysical Research-Oceans, 110*(C11), C11016.

Sarin, M., Krishnaswami, S., Dilli, K., Somayajulu, B., & Moore, W. (1989). Major ion chemistry of the Ganga-Brahmaputra river system: Weathering processes and fluxes to the Bay of Bengal. *Geochimica et Cosmochimica Acta, 53*(5), 997-1009.

Scheidat, M., Gilles, A., Kock, K., & Siebert, U. (2008). Harbour porpoise Phocoena phocoena abundance in the southwestern Baltic Sea. *Endangered species research*, 1-9.

Scheninin, A., Kerem, D., & Goffman, O. (2010). Personal Communication. University of Haifa.

Secchi, E., Danilewicz, D., & Ott, P. (2003). Applying the phylogeographic concept to identify franciscana dolphin stocks: implications to meet management objectives. *Journal of Cetacean Research and Management, 5*(1), 61-68.

Selzer, L., & Payne, P. (1988). The distribution of white-sided dolphins (Lagenorhynchus acutus) and common dolphins (Delphinus delphis) vs. environmental features of the continental shelf of the northeastern United States. *Mar. Mammal Sci, 4*, 141-153.

Sergeant, D. (1962). *The biology of the pilot or pothead whale Globicephala melaena (Traill) in Newfoundland waters*: Fisheries Research Board of Canada under the control of the honourable the Minister of Fisheries, Ottawa.

Shirakihara, M., Shirakihara, K., Tomonaga, J., & Takatsuki, M. (2002). A resident population of Indo-Pacific bottlenose dolphins (Tursiops aduncus) in Amakusa, western Kyushu, Japan. *Marine Mammal Science, 18*(1), 30-41.

Siebert, U., Gilles, A., Lucke, K., Ludwig, M., Benke, H., Kock, K., et al. (2006). A decade of harbour porpoise occurrence in German waters--Analyses of aerial surveys, incidental sightings and strandings. *Journal of Sea Research, 56*(1), 65-80.

Smith, B., Ahmed, B., Mowgli, R., & Strindberg, S. (2008). Species occurrence and distributional ecology of nearshore cetaceans in the Bay of Bengal, Bangladesh, with abundance estimates for Irrawaddy dolphins Orcaella brevirostris and finless porpoises Neophocaena phocaenoides. *The Journal of Cetacean Research and Management, 10*(1), 45-58.

Smith, B., Jefferson, T., Ho, D., Leatherwood, S., Thuoc, C., Andersen, M., et al. (1995). Marine mammals of Vietnam: a preliminary checklist. *Tuyen Tap Nghien Cuu Bien (Collection of Marine Research Works), 6*, 147-176.

Somayajulu, Y., Murty, V., & Sarma, Y. (2003). Seasonal and inter-annual variability of surface circulation in the Bay of Bengal from TOPEX/Poseidon altimetry. *Deep Sea Research Part II: Topical Studies in Oceanography, 50*(5), 867-880.

Sparks, T. (1997). *Distributions of sperm whales along the continental slope in the northwestern and central Gulf of Mexico as determined from an acoustic survey.* Texas A& M University.

Stafford, K., Nieukirk, S., & Fox, C. (2001). Geographic and seasonal variation of blue whale calls in the North Pacific. *Journal of Cetacean Research and Management, 3*(1), 65-76.

Steele, J. H., Collie, J. S., Bisagni, J. J., Gifford, D. J., Fogarty, M. J., Link, J. S., et al. (2007). Balancing end-to-end budgets of the Georges Bank ecosystem. *Progress In Oceanography, 74*(4), 423-448.

Stone, G., Katona, S., & Tucker, E. J. B. C. (1987). History, migration and present status of humpback whales Megaptera novaeangliae at Bermuda. *42*(2), 133-145.

Strindberg, S., Ersts, P., Collins, T., Sounguet, G., & Rosenbaum, H. (In Press). Line Transect Estimates of Humpback Whale Abundance and Distribution on their Wintering Grounds in the Coastal Waters of Gabon. *Journal of Cetacean Research and Management.*

Subrahmanyam, V., Krishna, K., Ramana, M., & Murthy, K. (2008). Marine geophysical investigations across the submarine canyon (Swatch-of-No-Ground), northern Bay of Bengal. *Current Science, 94*(4), 507-513p.

Tomilin, A. (1967). Mammals of the USSR and adjacent countries. *Vol. IX. Cetacea. Moscow, Soviet Union (English translation, 1967, Israel Program for Scientific Translations, Jerusalem, Israel).*

Townsend, C. (1935). The distribution of certain whales as shown by logbook records of American whaleships. *Zoologica, 19*(1), 1-50.

Tyack, P., & Whitehead, H. (1982). Male competition in large groups of wintering humpback whales. *Behaviour*, 132-154.

Van Waerebeek, K., Barnett, L., Camara, A., Cham, A., Diallo, M., Djiba, A., et al. (2004). Distribution, Status, and Biology of the Atlantic Humpback Dolphin, Sousa teuszii (Kukenthal, 1892). *Aquatic Mammals, 30*(1), 56-83.

Vella, A. (2005). Common dolphin *Delphinus delphis* research and conservation requirements in the Central Mediterranean around the Maltese Islands. In K. Stockin, A. Vella, P.G.H. Evans. Common dolphins: current research, threats and issues. *ECS Newsletter N. 45, Special Issue July 2005,* 4-12.

Verfuß, U., Honnef, C., Meding, A., Dähne, M., Mundry, R., & Benke, H. (2007). Geographical and seasonal variation of harbour porpoise (Phocoena phocoena) presence in the German Baltic Sea revealed by passive acoustic monitoring. *Journal of the Marine Biological Association of the UK, 87*(01), 165-176.

Vigness-Raposa, K., Kenney, R., Gonzalez, M., & August, P. (2009). Spatial patterns of humpback whale (Megaptera novaeangliae) sightings and survey effort: Insight into North Atlantic population structure. *Marine Mammal Science, 26*(1), 161-175.

Wada, S. (1988). Genetic differentiation between two forms of short-finned pilot whales off the Pacific coast of Japan. *Sci Rep Whales Res Inst, 39*, 91-101.

Walsh, P., Fay, J., Gulick, S., & Sounguet, G. (2000). Humpback whale activity near Cap Lopez, Gabon. *Journal of Cetacean Research and Management, 2*(1), 63-68.

Wang, J., & Yang, S. (2007). *An identification guide to the dolphins and other small cetacean of Taiwan.*: Jen Jen Publishing Co., Ltd.

Wang, P. (1999). Chinese cetaceans. *Hong kong: Ocean Enterprises Ltd*.

Waring, G., Josephson, E., Fairfield-Walsh, C., & Maze-Foley, K. (2009). US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments--2008. *NOAA Tech Memo NMFS NE 210, 210*(440), 02543-01026.

Watkins, W., Daher, M., Reppucci, G., George, J., Martin, D., DiMarzio, N., et al. (2000). Seasonality and distribution of whale calls in the North Pacific. *OCEANOGRAPHY-WASHINGTON DC-OCEANOGRAPHY SOCIETY-, 13*(1), 62-67.

WCS. (2010). Wildlife Conservation Society, Antongil Bay Seascape, Madagascar. Retrieved September 14, 2010, 2010, from http://www.wcs.org/saving-wild-places/ocean/antongil-bay-seascape.aspx

Weir, C. (2006a). First confirmed records of Clymene dolphin, Stenella clymene (Gray, 1850), from Angola and Congo, south-east Atlantic Ocean. *African Zoology, 41*(2), 297-300.

Weir, C. (2006b). Short Communication Sightings of beaked whales (Cetacea: Ziphiidae) including first confirmed Cuvier's beaked whales Ziphius cavirostris from Angola. *African Journal of Marine Science, 28*(1), 173-175.

Weir, C. (2007). Occurrence and distribution of cetaceans off Northern Angola, 2004/05. *The Journal of Cetacean Research and Management, 9*(3).

Whitehead, H., Gowans, S., Faucher, A., & McCarrey, S. (1997). Population analysis of northern bottlenose whales in the Gully Nova Scotia. *Marine Mammal Science, 13*(2), 173-185.

Whitehead, H., & Moore, M. (1982). Distribution and movements of West Indian humpback whales in winter. *Canadian Journal of Zoology, 60*(9), 2203-2211.

Wimmer, T., & Whitehead, H. (2004). Movements and distribution of northern bottlenose whales, Hyperoodon ampullatus, on the Scotian Slope and in adjacent waters. *Canadian Journal of Zoology, 82*(11), 1782-1794.

Winn, H. (1982). A characterization of marine mammals and turtles in the Mid-and North Atlantic areas of the US outer continental shelf. *Final report. Sponsored by the Bureau of Land Management under contract AA551-CT8-48. 450pp*.

Yamada, T. (2009). *Balaenpotera omurai Wada, Oishi & Yamada, 2003. Pages 330-331, In: The Wild Mammals of Japan.* Kyoto: Shoukadoh Book Sellers.

Yen, P. P. W., Sydeman, W. J., & Hyrenbach, K. (2004). Marine bird and cetacean associations with bathymetric habitats and shallow- water topographies: implications for trophic transfer and conservation. *Journal of Marine Systems, 50*(1-2), 79-99.

Yoshida, H., Shirakihara, K., Kishino, H., & Shirakihara, M. (1997). A population size estimate of the finless porpoise, Neophocaena phocaenoides, from aerial sighting surveys in Ariake Sound and Tachibana Bay, Japan. *Researches on Population Ecology, 39*(2), 239-247.

Zhou, K. (2002). Marine mammal research and conservation in China. *Fisheries Science, 68*((Supplement 1)), 244-247.

Zhou, K. (2004). Cetacea Carnivora: Phocoidea, Sirenia. Fauna Sinica, Mammal 9:vi, 326.

Zhou, K., Leatherwood, S., & Jefferson, T. (1995). Records of small cetaceans in Chinese waters: a review. *Asian Marine Biology, 12*, 119-139.

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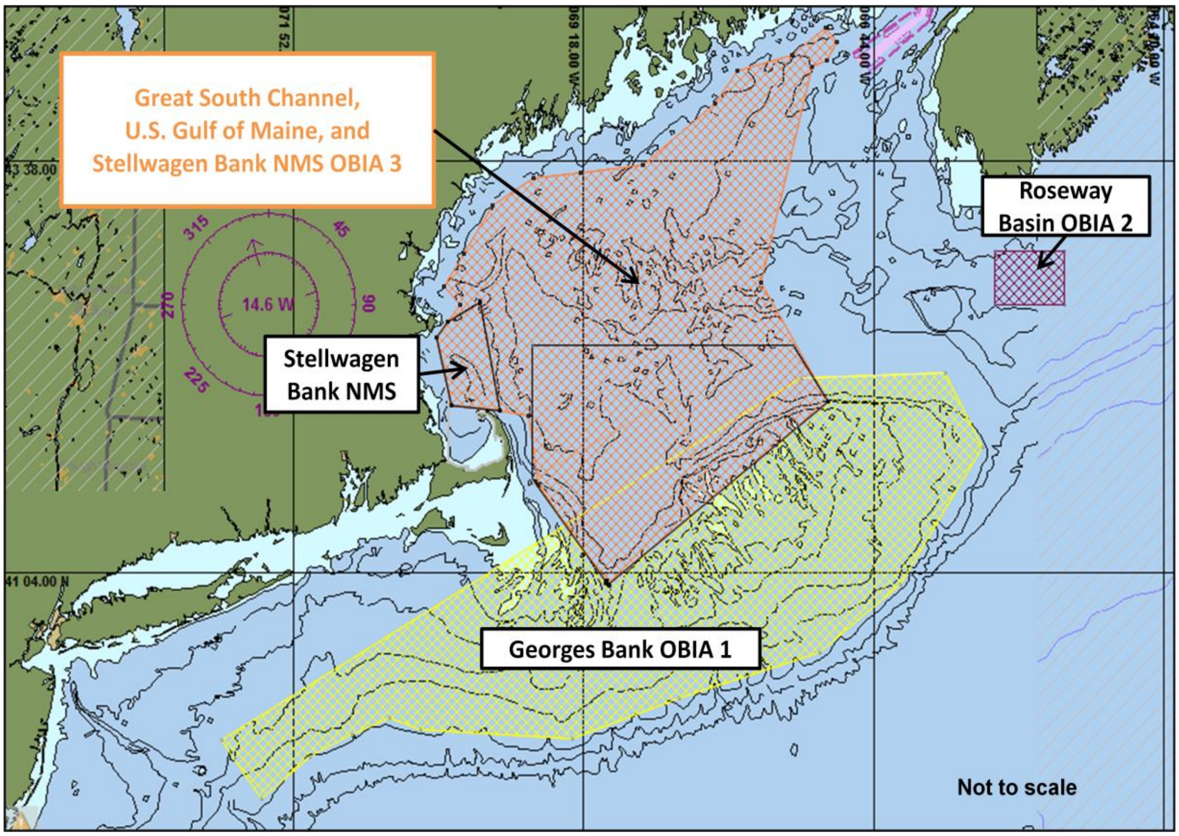
APPENDIX D-8: MAP FIGURES OF FINAL SURTASS LFA SONAR MARINE MAMMAL OBIAS, APRIL 2011

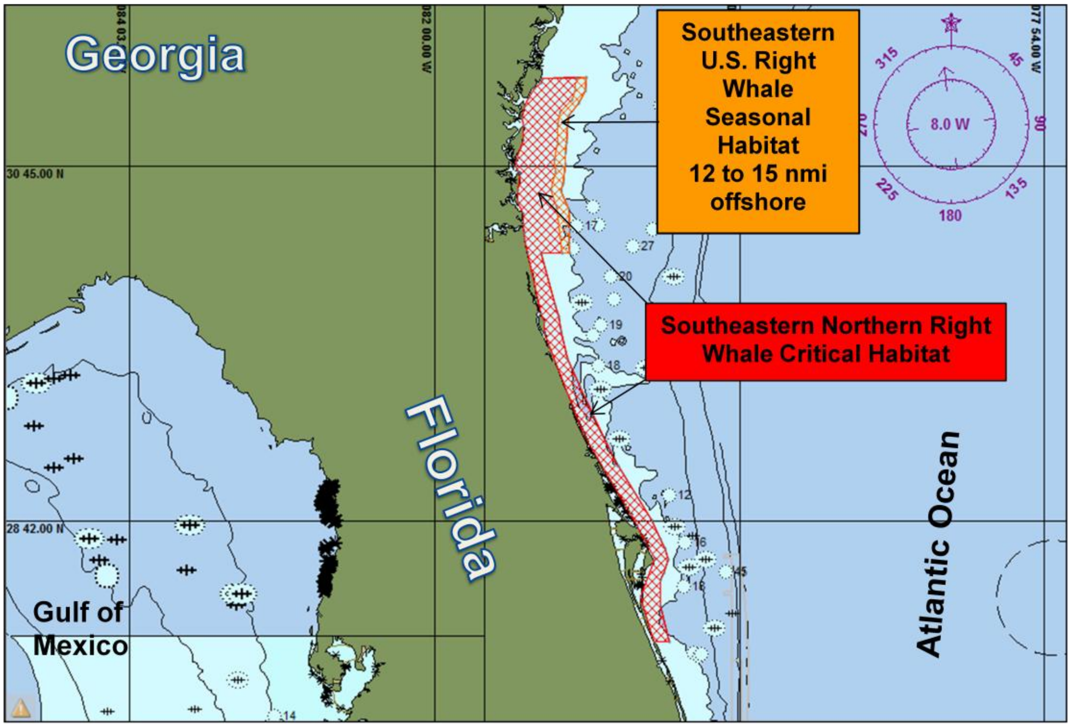
OBIA AREA NUMBER 1: GEORGES BANK

OBIA AREA NUMBER 2: ROSEWAY BASIN RIGHT WHALE CONSERVATION AREA

OBIA AREA NUMBER 3: GREAT SOUTH CHANNEL/U.S. GULF OF MAINE/STELLWAGEN BANK NMS

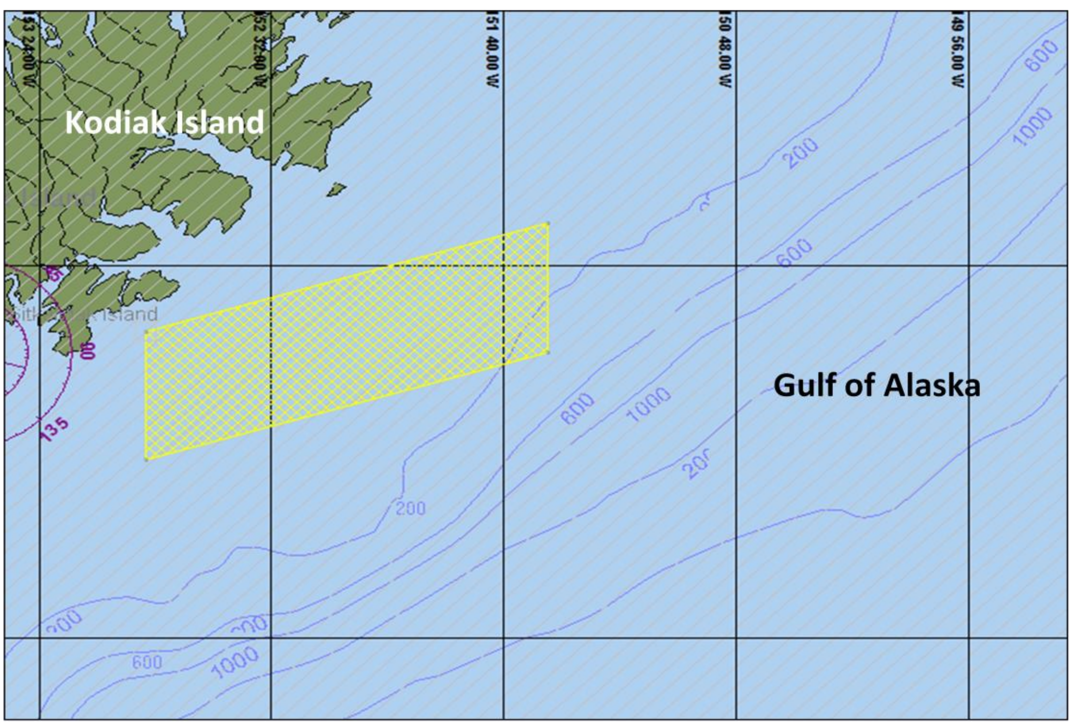


OBIA AREA NUMBER 4: SOUTHEASTERN U.S. RIGHT WHALE SEASONAL HABITAT



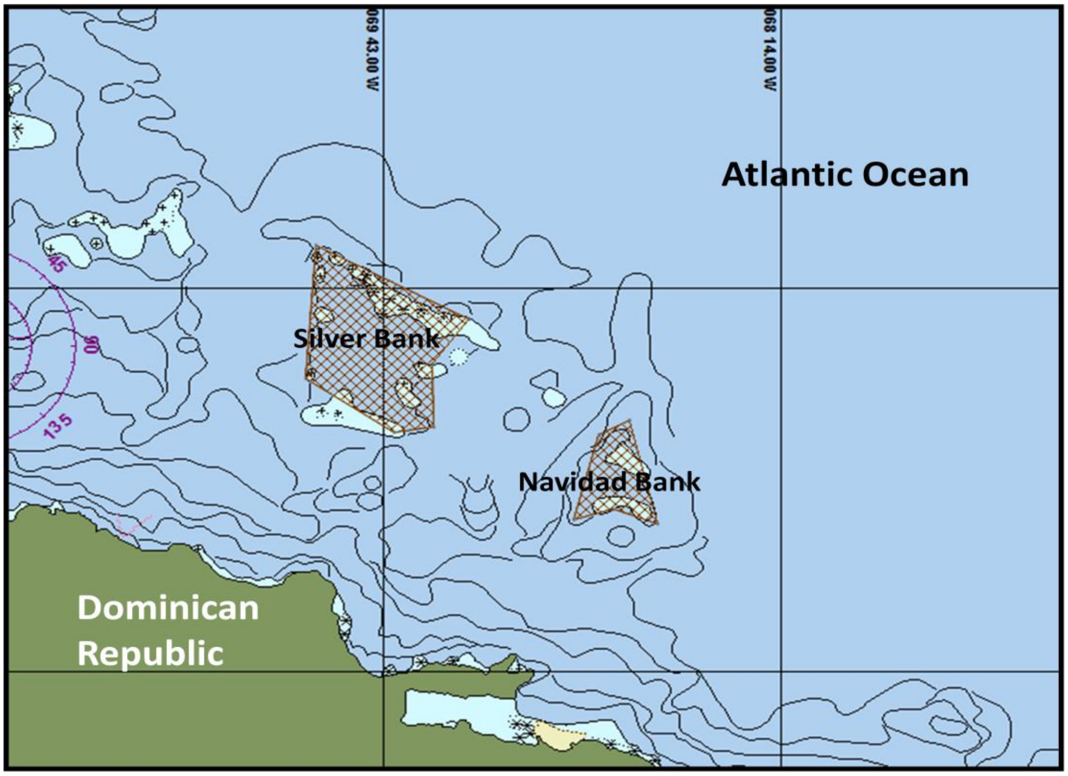
Not to Scale

OBIA AREA NUMBER 5: NORTH PACIFIC RIGHT WHALE CRITICAL HABITAT



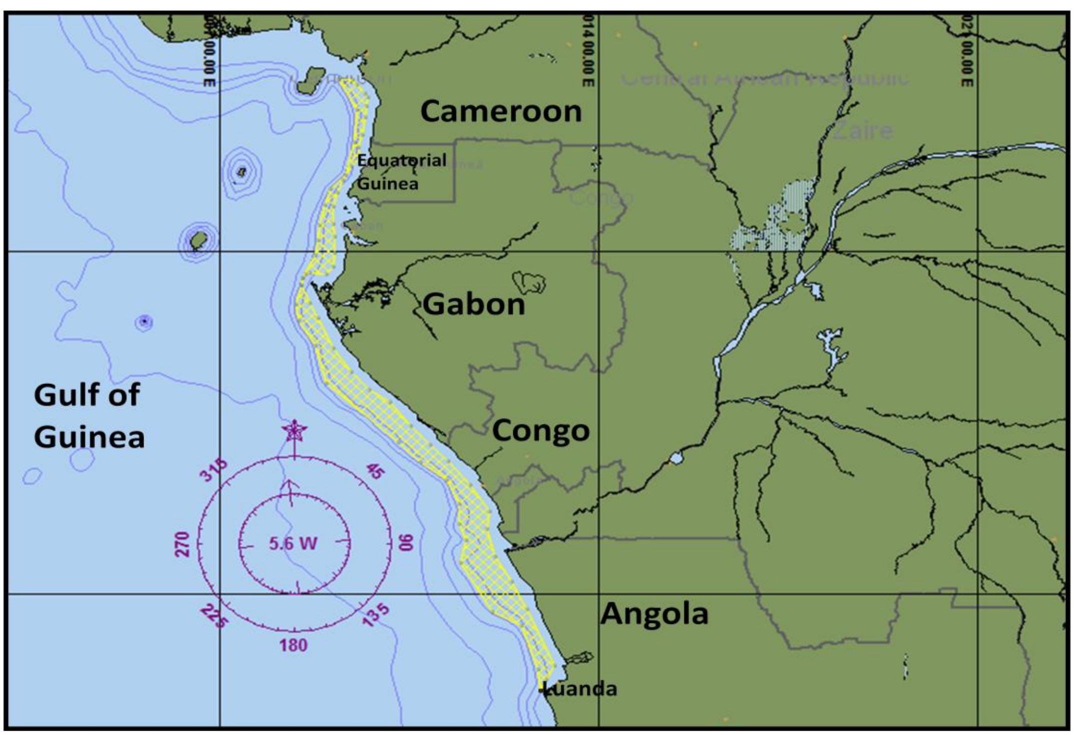
Not to Scale

OBIA AREA NUMBER 6: SILVER BANK AND NAVIDAD BANK

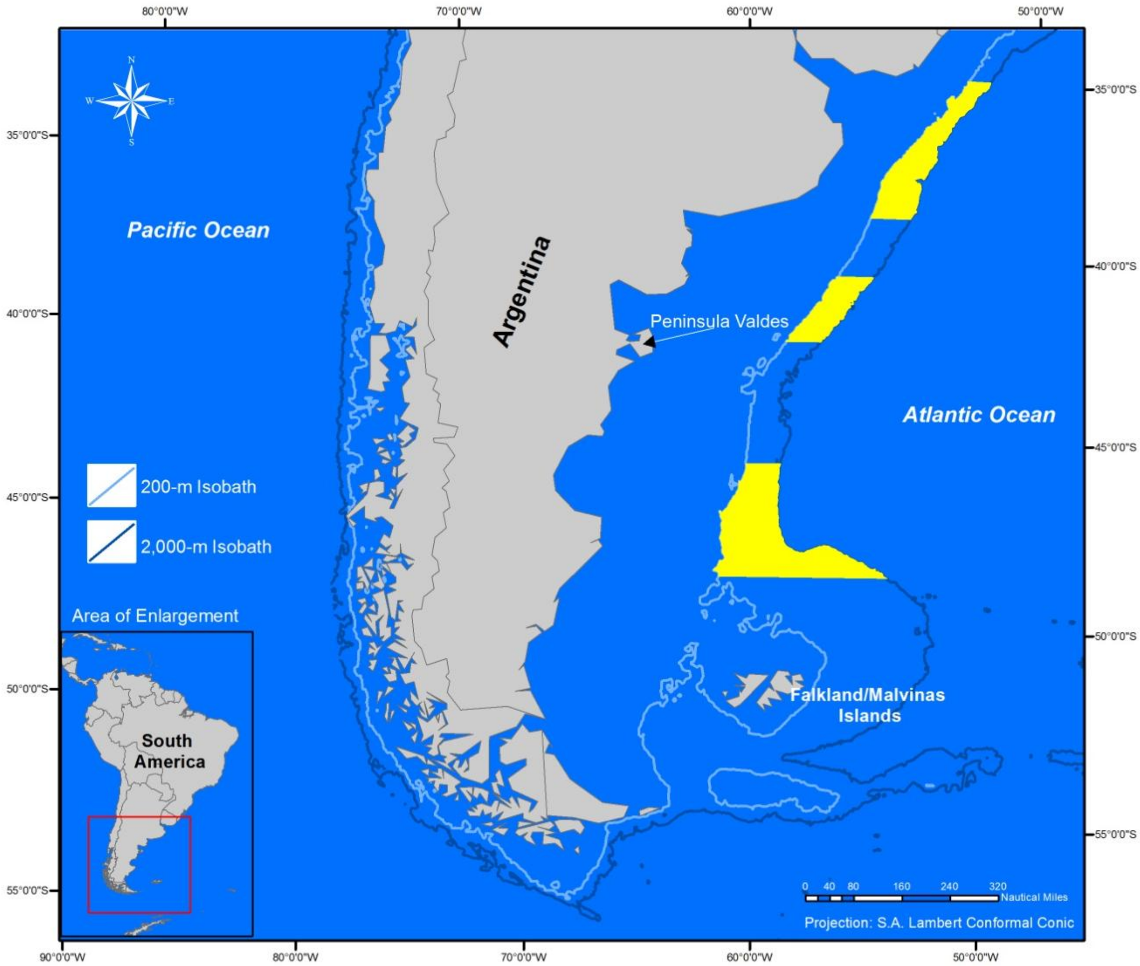


Not to Scale

OBIA AREA NUMBER 7: COASTAL WATERS OF GABON, CONGO, AND EQUATORIAL GUINEA



1 **OBIA AREA NUMBER 8: PATAGONIAN SHELF BREAK**



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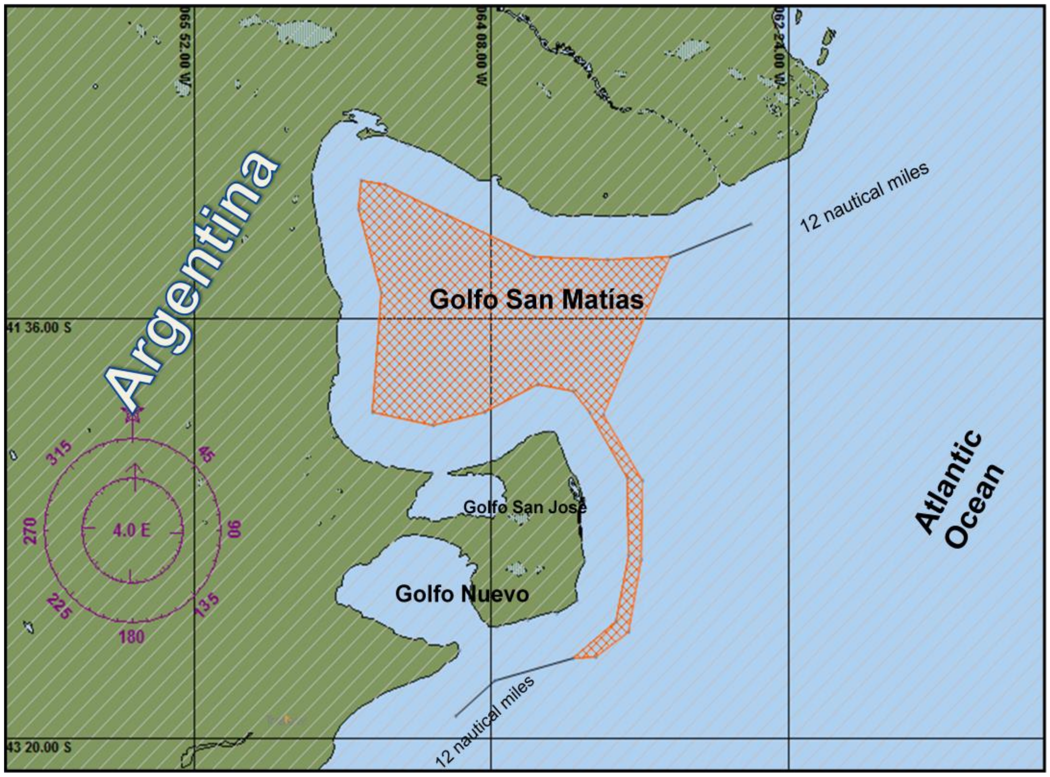
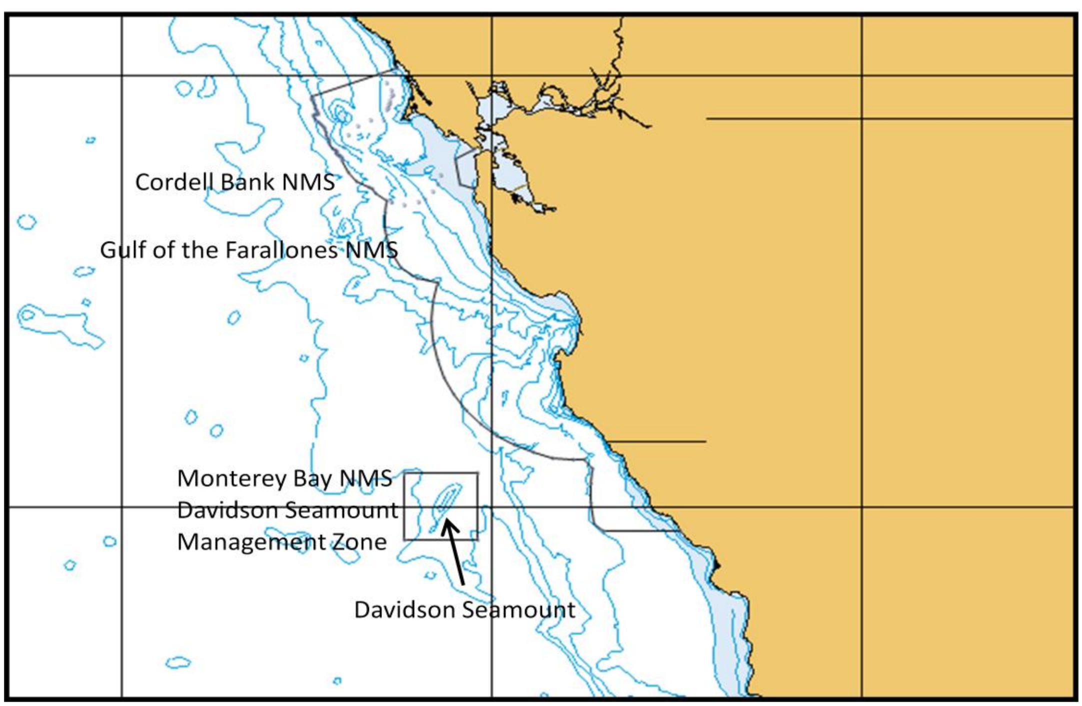
OBIA AREA NUMBER 9: SOUTHERN RIGHT WHALE SEASONAL HABITAT

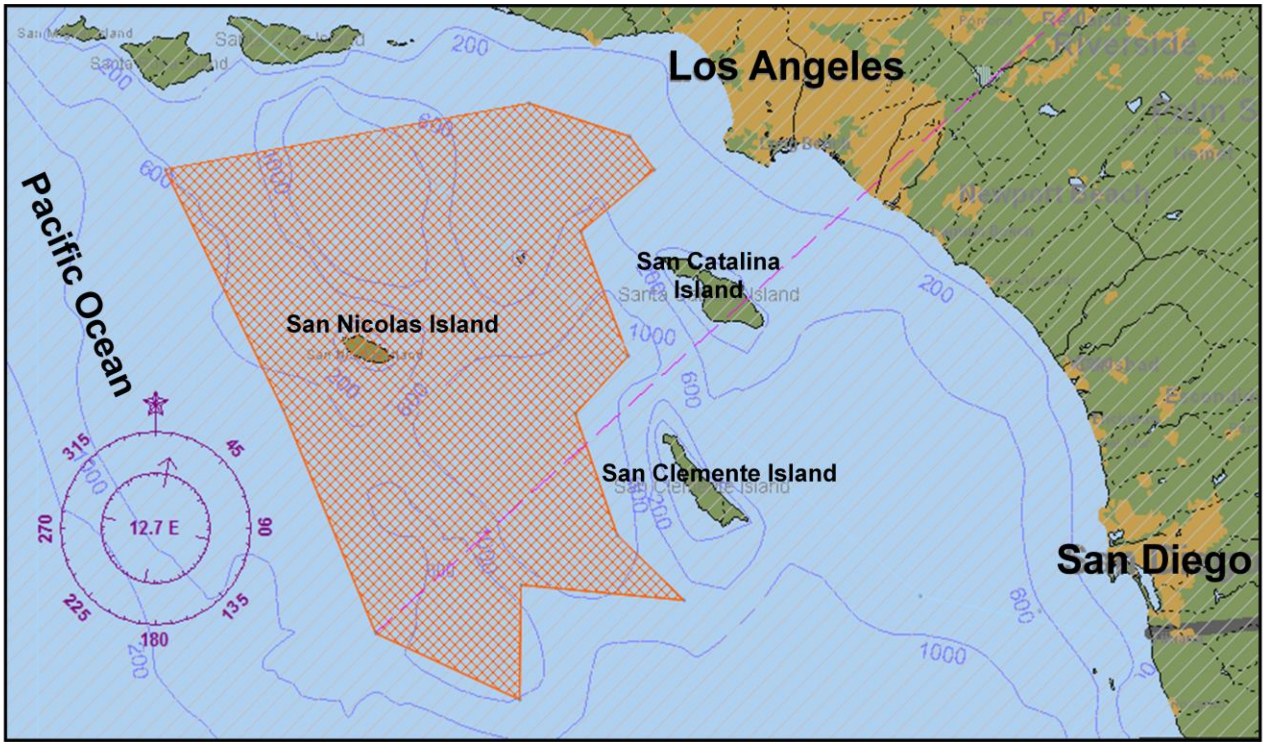


Not to Scale

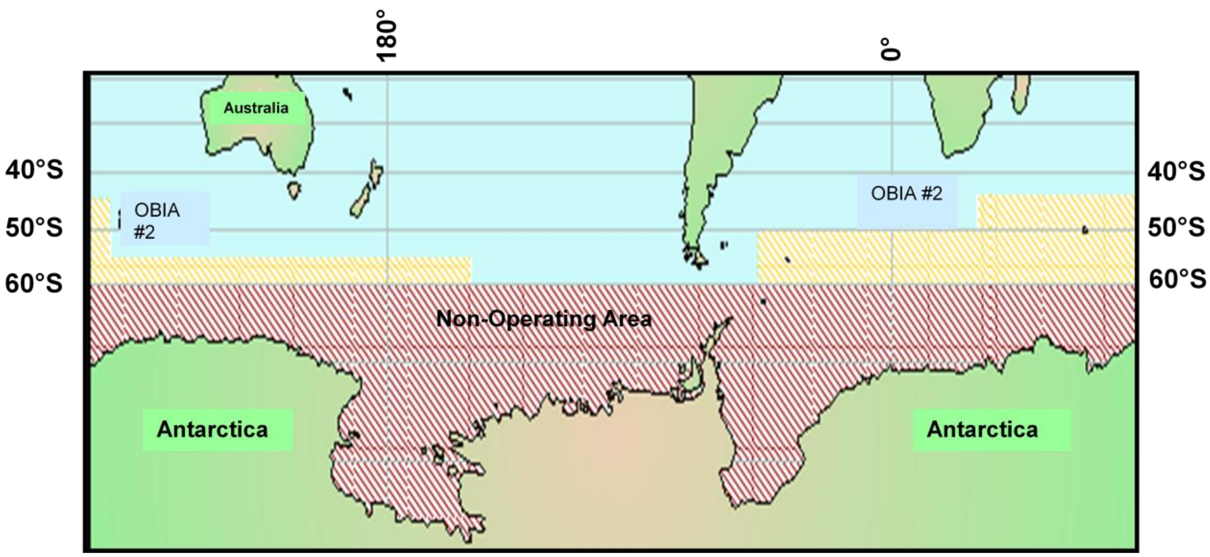
OBIA AREA NUMBER 10: CENTRAL CALIFORNIA NATIONAL MARINE SANCTUARIES



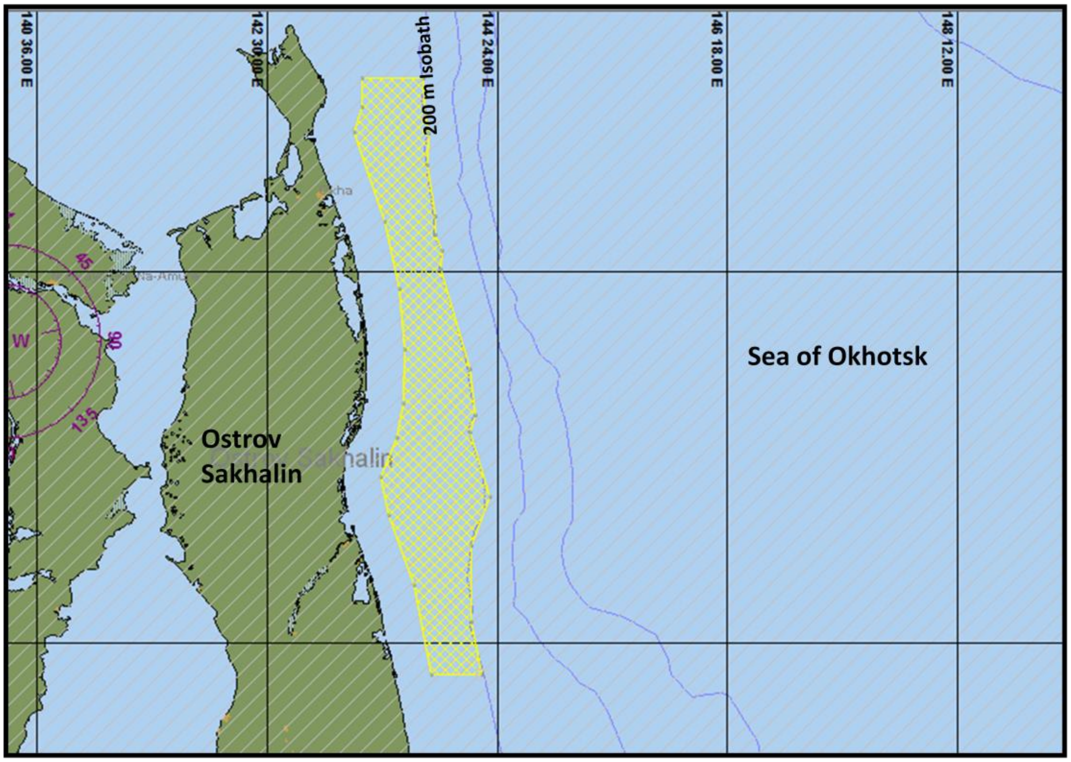
OBIA AREA NUMBER 11: SOUTHERN CALIFORNIA BIGHT



OBIA AREA NUMBER 12: ANTARCTIC CONVERGENCE ZONE



OBIA AREA NUMBER 13: PILTUN AND CHAYVO OFFSHORE FEEDING GROUNDS—SEA OF OKHOTSK



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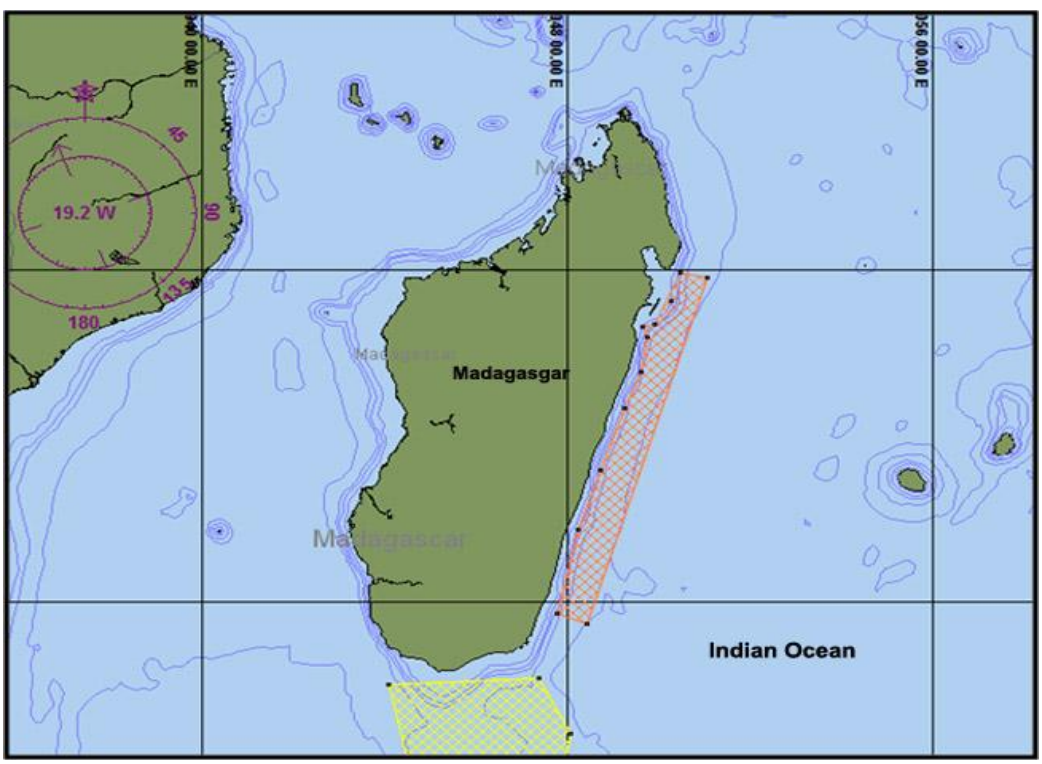
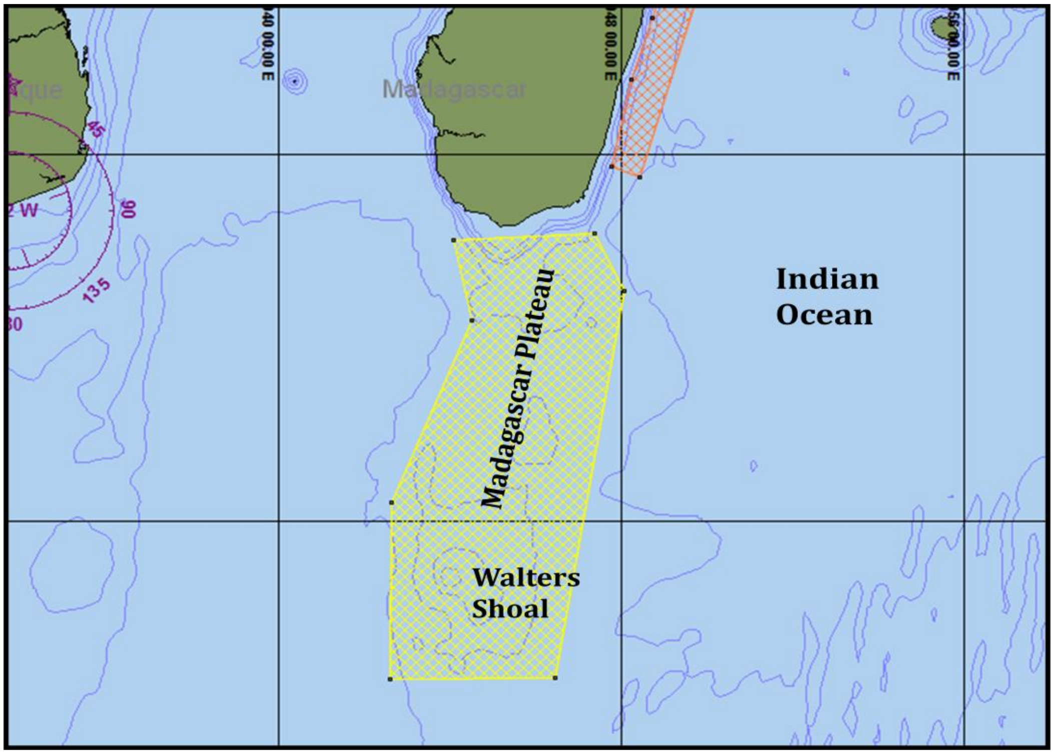
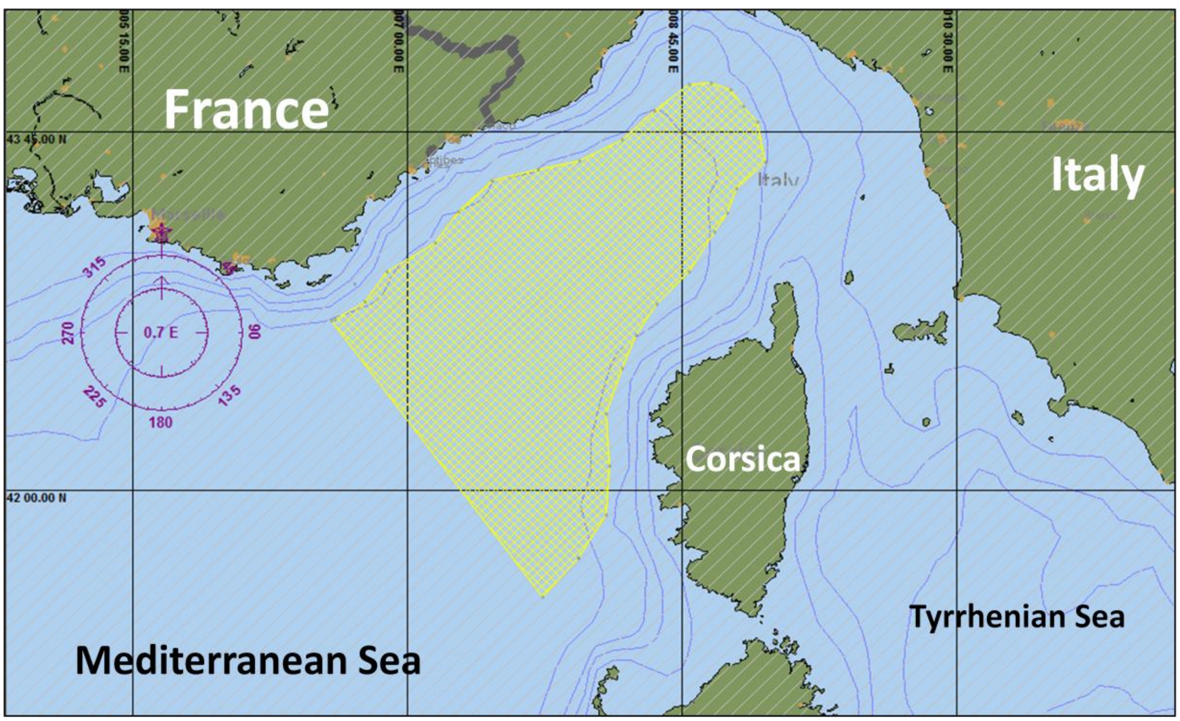
OBIA AREA NUMBER 14: COASTAL WATERS OFF MADAGASCAR



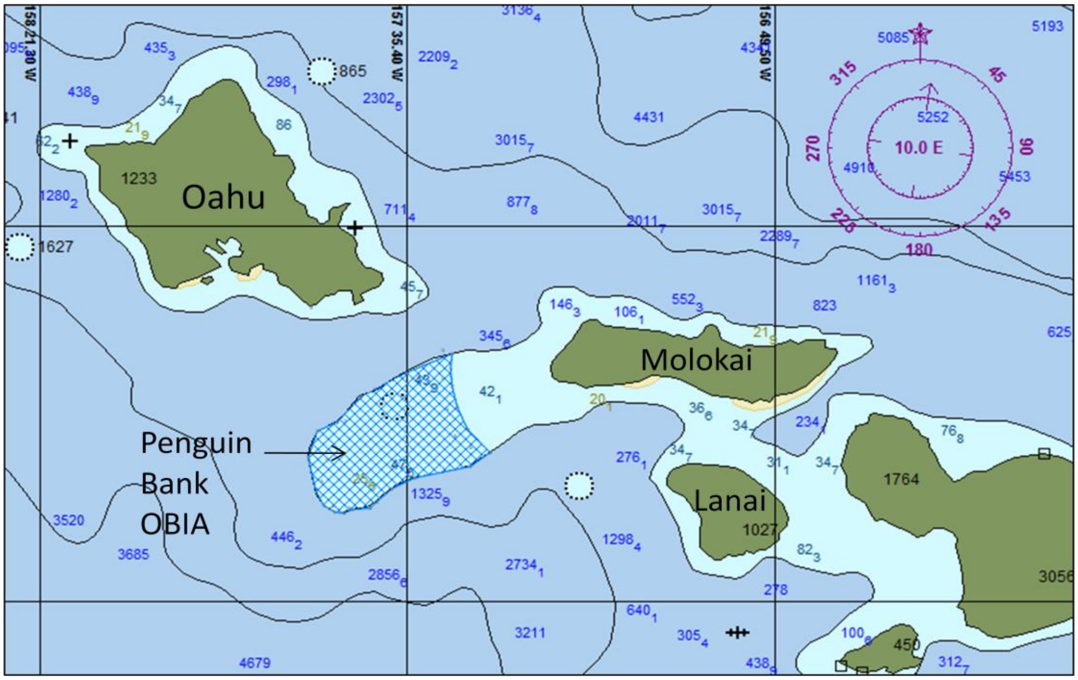
<u>OBIA AREA NUMBER 15: MADAGASCAR PLATEAU, MADAGASCAR RIDGE, AND WALTERS SHOAL</u>



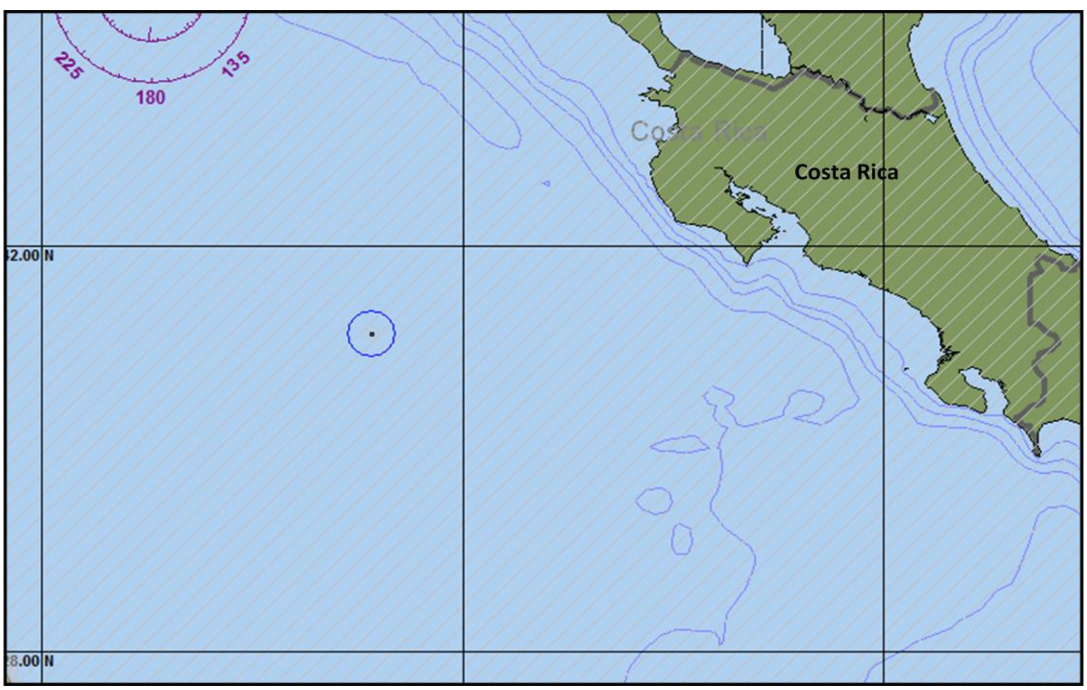
<u>OBIA AREA NUMBER 16: LIGURIAN-CORSICAN-PROVENÇAL BASIN AND WESTERN PELAGOS SANCTUARY</u>



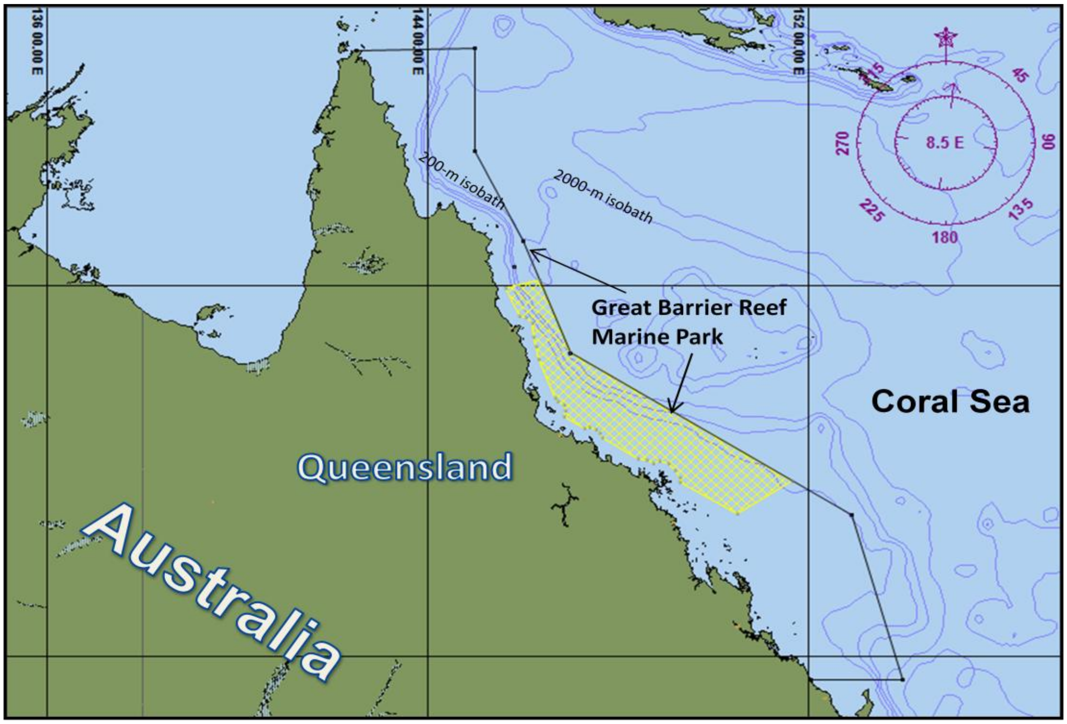
<u>**OBIA AREA NUMBER 17: HAWAIIAN ISLAND HUMPBACK WHALE NMS—PENGUIN BANK**</u>



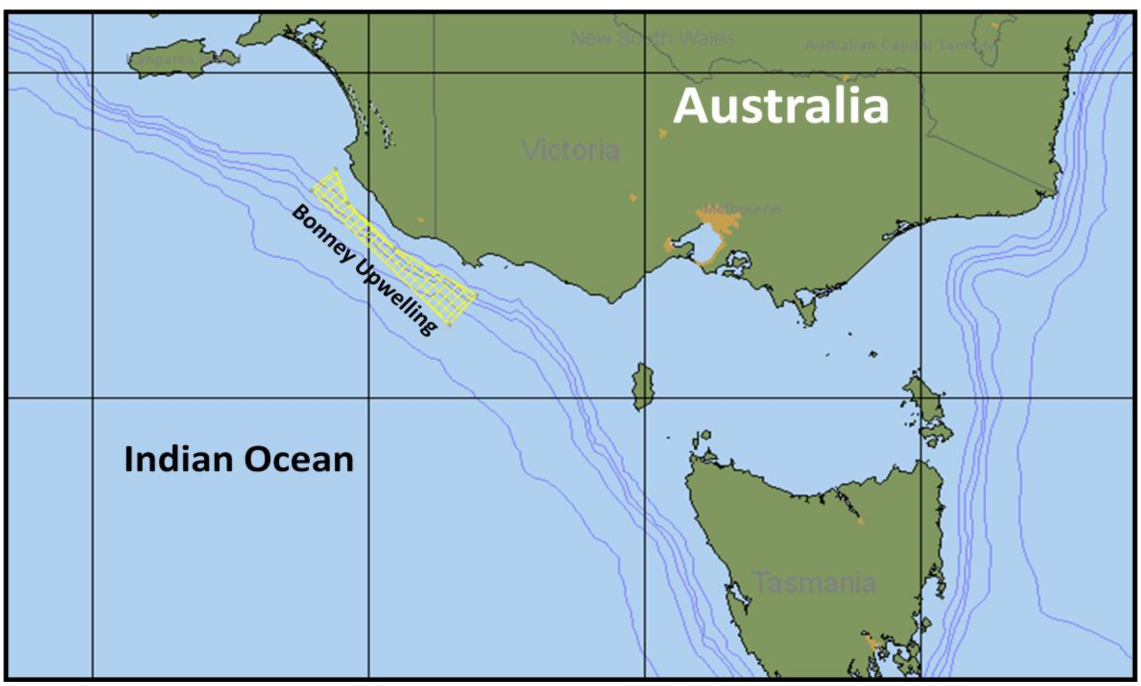
<u>**OBIA AREA NUMBER 18: COSTA RICA DOME**</u>



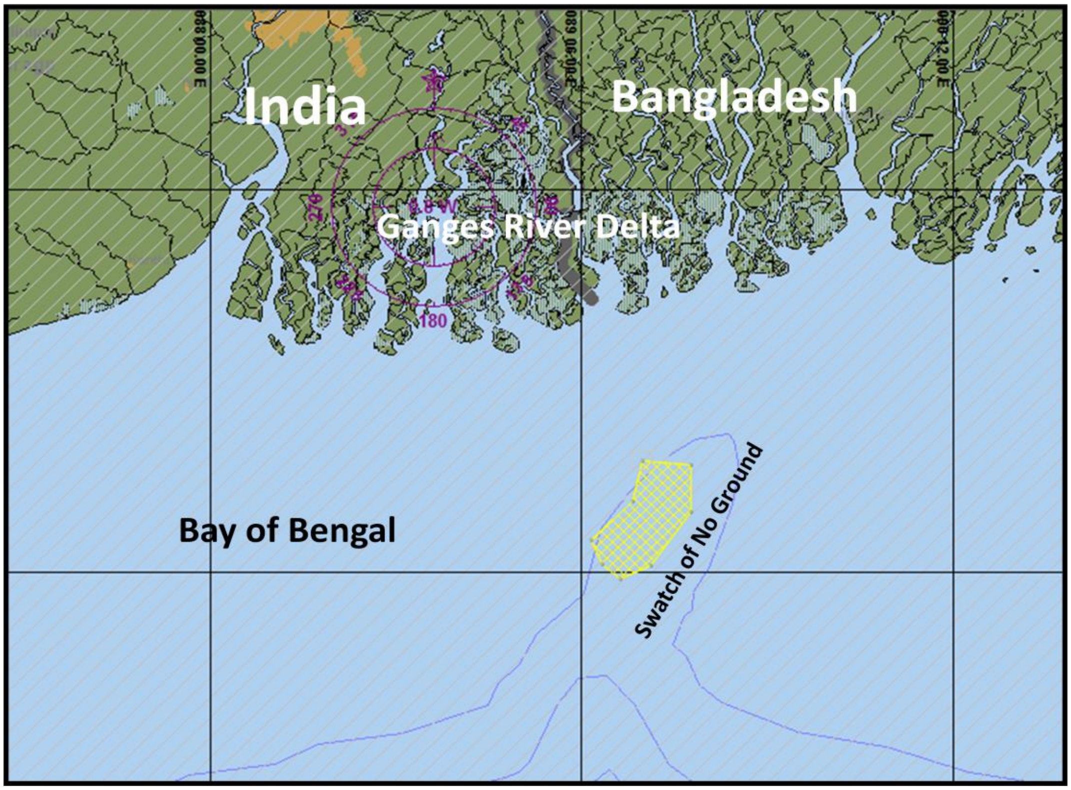
OBIA AREA NUMBER 19: GREAT BARRIER REEF BETWEEN 16°S AND 21°S



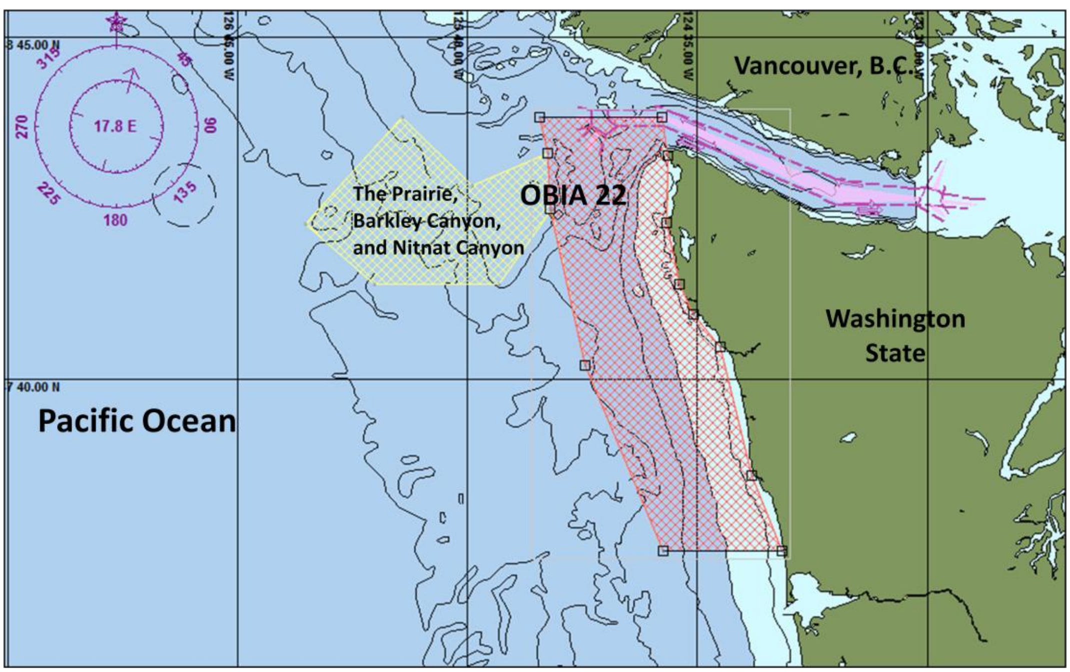
OBIA AREA NUMBER 20: BONNEY UPWELLING



OBIA AREA NUMBER 21: NORTHERN BAY OF BENGAL AND HEAD OF SWATCH-OF-NO-GROUND (SONG)



OBIA AREA NUMBER 22: OLYMPIC COAST: THE PRAIRIE, BARKLEY CANYON, AND NITNAT CANYON



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APPENDIX E

DETAILED ANALYSIS FOR POTENTIAL MMPA LEVEL B EFFECTS FROM THE CUMULATIVE EFFECTS OF CONCURRENT LFA AND MFA SONAR OPERATIONS

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E-1.0 DISCUSSION OF THE PROBLEM AND POSSIBLE APPROACHES TO THE SOLUTION

This appendix provides more information on the analyses the Navy conducted regarding the potential effects when SURTASS LFA sonar and MFA sonar (AN/SQS-53C) may be operating concurrently. The question of whether the effects of two active sonar systems with different operating characteristics (i.e., frequency, pulse length, waveforms, etc.) operating concurrently is greater than the effects from each system operating individually is complex given the multitude of environments and conditions possible in the oceans of the world. The variables that can influence how the two sonar transmissions could combine and thus influence their potential for effects on marine mammals include:

- Each sonar’s frequency, transmitted source level, the water depth of the source, the transmitted beam pattern, waveform type, transmission duration, and interval between transmissions, etc.;
- The location of each source and the course and speed of the source’s vessel over the duration of the evolution or exercise;
- The underwater sound propagation paths present in the area, their extent and variability (including diurnal patterns and other short-term variations as well as seasonal and other, longer-term variations, [such as El Niño], local weather, tides, and the general variability of the water mass due to currents, ocean fronts, eddies, etc.);
- The variability of the ocean surface (i.e., wave heights) and seafloor characteristics throughout the area;
- The animal species potentially present in the area, their distribution, abundance and density;
- The activities those species are involved in, which influences the depths where they are found in the water column, and how they are moving through the area (i.e., migrating, searching for food, feeding, searching for mates, breeding, etc.);
- The hearing sensitivity for these species in the frequencies transmitted by each of the sources; and
- The other noise present across the frequencies of interest, such as naturally-occurring noise from high wind conditions, rain and/or lightning storms, and earthquakes, as well as man-made noise such as shipping noise, explosions and seismic airgun operations.

For the purposes of analyzing potential effects of SURTASS LFA sonar and MFA sonar, these complexities can be better managed, because some of the variables are known, and others can be simplified through use of reasonable and conservative assumptions:

- To simplify the analysis, with negligible loss of accuracy, a single representative frequency for each sonar system was used.
- Actual source depths for SURTASS LFA sonar (122 m [400 feet]) and for the MFA sonar (8 m [26.2 ft]) were used.
- Because analyzing all of the potential operation areas where overlapping SURTASS LFA sonar and MFA sonar transmissions could occur is infeasible, representative areas in the North Pacific Ocean were used. These areas were chosen because they represent areas where concurrent

SURTASS LFA and MFA sonar operations are most probable in the near term and convergence zone (CZ) sound propagation[133] is most prominent. Analysis of other oceanic areas where CZ propagation is most prominent would be expected to yield negligible differences in results from those presented here.

- A reasonable estimation of risk from concurrent operations of LFA and MFA sonars can be derived from the LFA risk continuum curve (see Figure 4.7-2). Generally conservative values were used for most of the sonar operating parameters for both systems (i.e., source level, waveform type, transmission duration, interval between transmissions, etc.). For example, maximum source level for particular sonar operating modes, longer duration transmissions and shorter intervals between transmissions were used, all of which should notionally increase the potential for effects.
- The widest and most volume-ensonifying beam patterns for each source were used. For the MFA sonar, an omni-directional beam pattern (i.e., 360 degrees in 3D) was assumed, although in fact a significant volume of the beam pattern is blocked by the ship's hull. For LFA sonar, an omni-directional beam pattern in the horizontal plane was assumed, with the narrow sonar beam vertically-steered a nominal ±10 degrees from the horizontal. The ensuing ensonified area can be likened to a flat disk centered on the LFA source array, which is mounted on a vertical line array beneath the ship. The differences in the beam patterns for the two sonars are due primarily to differences in their construction, with LFA sonar being deployed below the ship and MFA sonar being mounted on the forward hull of the ship.

Existing LFA and MFA sonar analytical methodologies are dissimilar (e.g., the LFA sonar risk continuum uses a 60-sec transmission, while MFA sonar uses a 1-sec transmission). Because the LFA sonar risk continuum allows for the addition of acoustic energy from multiple underwater sound sources and provides an estimated animal exposure level as if that energy comes from a single source, it was used for this analysis.

It should be noted that there is a lack of scientific data on analytical methodologies to address whether or not (or under what circumstances) an animal will behave differently in the presence of two or more sources. Therefore, it was necessary to make the reasonable and conservative assumptions stated above, and to recognize the limitations of the available analysis techniques.

Based on the above assumptions and discussion, the potential effects from concurrent MFA and LFA sonar operations were analyzed using two distinct approaches as defined in Subchapter 4.7.4.1.2:

- Parametric analysis (Section E-2.0; and
- Acoustic Integration Model analyses (Section E-3.0)

[133] A convergence zone is a region in the deep ocean where sound rays, refracted from the depths, arrive at the surface in successive intervals of 55 to 64 km (30 to 35 nm). The repeated occurrence of these zones to several hundred miles from the sound source depends on the refraction of sound at depth and the reflection of these rays at the surface.

E.2.0 PARAMETRIC ANALYSIS

Typically, in dimensional analyses[134] the complexity and number of the dimensions or quantities acting on the variables is such that several dimensionless parameters/numbers are ultimately used to understand and visualize how the variables react under varying conditions (an example of this will be presented below). However, for this acoustic analysis, a single parameter (i.e., the range between a receiver location and the source locations, which acoustically equates to the transmission loss [TL] as a function of range and depth) will ultimately control how the variable (i.e., potential acoustic impacts to a species) is affected. Thus, this dimensional analysis will be simplified into a single dimensional analysis, or a "parametric analysis[135]."

Technically, the sound propagation is a function of both the receiver (animal) depth and the range of that receiver (animal) from the sound source. However, there are other ways to quantify a sound propagation type (at least approximately). For example, sound propagation via a CZ can be quantified by the range to the CZ annulus[136] (i.e., the distance from the sound source to the point where the CZ returns to the ocean surface [typically 30 to 35 nm in the North Pacific Ocean]). Effectively, the range to a CZ's annulus is therefore a "critical acoustic parameter;" in this case the "critical acoustic distance" which can be used to characterize the sound propagation for the modeled water volume. Additionally, since the distance between the sound sources determines the range from each modeled location and the TL from each sound source to that location, the distance between the sound sources is a variable, which will change the average risk per modeled location in the modeled water volume. Thus, when these factors are combined, a dimensionless parameter consisting of their ratio is produced.

$$\frac{\text{Distance between the sound sources (km or nm)}}{\text{Critical acoustic distance (km or nm)}} = \text{dimensionless parameter} \qquad (1)$$

The critical acoustic distance will be different for each type of sound propagation condition encountered. For example, for ducted sound propagation, it will still be a constant, but related to the depth of the duct, which in turn identifies which sound frequencies will be trapped in the duct. Regardless of what the critical acoustic distance is, the examination of the above dimensionless number (equation [1]) will provide insight into how the variable (i.e., average risk per modeled location) will change as a function of the dimensionless parameter. Since it appears that this analysis can be performed through the use of a single dimensionless parameter (i.e., the dimensionless ratio of equation [1]), coupled with the resulting effects on marine animals in the region of overlap of the LFA and MFA sonar sound fields, this dimensional analysis has been simplified to a "parametric analysis," and will be identified as such for the remainder of this appendix. Finally, since the critical acoustic distance is a fixed value (i.e., a constant) for a modeled sound propagation condition (for this CZ propagation condition it is about 60 km or 32.4 nm), the dimensionless value of the distance between the sound sources can also be applied during this analysis. To do this entails the additional step of dividing that distance by the critical acoustic distance in order to "normalize" the relationship and represent the data as a function of the dimensionless parameter.

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[134] Dimensional analysis defined by Avallone et al. (1987) as "the mathematics of dimensions and quantities and provides procedural techniques whereby the variables that are assumed to be significant in a problem can be formed into dimensionless parameters, the number of parameters being less than the number of variables."

[135] Parametric analysis is a methodology to describe and examine the relationship between different parameters, (e.g., in this case acoustic transmission loss as a function of range and depth) and the variable (e.g., potential acoustic impact to marine mammals) that it/they influence or affect.

[136] The CZ annulus is the sea surface areal extent of the sound energy that has traveled from the sound source via the CZ propagation path. The annulus width is nominally about 10% of the distance from the sound source to the CZ annulus.

E-2.1 INITIAL ANALYSES ASSUMPTIONS AND APPROACH

Given that the critical acoustic distance is the significant parameter, the remaining factor needed to quantify the underwater sound fields is the underwater sound propagation, or TL between the sound sources and the modeled locations surrounding each sound source.

Underwater sound propagation and the sound speed profiles[137] (SSPs) of the North Pacific Ocean have been studied and reported on for decades (Podezwa, 1976; NAVOCEANO, 1982; Kerr et al., 1994; JASA, 2005) and are fairly well known and documented in the existing acoustic databases (OAML, 2002). Based on these reports, and the modeling efforts using these databases, the deep-water (waters not on either a continental shelf or slope) sound propagation in the North Pacific Ocean can be characterized into three general categories: 1) surface duct[138] or half-channel[139]; 2) convergence zone (CZ); and 3) bottom-limited[140]. Most of the surface duct or half-channel sound propagation occurs north of latitude 45°N for the eastern North Pacific Ocean and north of about 42°N for the western North Pacific Ocean. The remainder of the North Pacific Ocean typically shows CZ propagation if the water is deep enough to allow the sound rays to bend at their deepest point without striking the bottom. Otherwise, the initial CZ-like sound propagation encounters the ocean bottom and is reflected off it (hence, it would be bottom-limited). It varies somewhat by season, but approximately 90% of the North Pacific Ocean, between 20°N and the ducted northern regions, supports CZ sound propagation. Thus, CZ sound propagation is a reasonable initial representative for deep-water propagation in the North Pacific Ocean. To simplify this analysis, and because it reflects the most probable water depths for concurrent LFA and MFA sonar operations, this parametric analysis will focus on deep water and CZ sound propagation.

Sample SSPs from approximately 30°N/155°E (i.e., in the Philippine Sea) were extracted from the Generalized Digital Environmental Model (GDEM[141]) database and used for the CZ modeling. This SSP generates a characteristic CZ for a shallow (i.e., about 8 m [26.2 ft] deep) MFA sonar at a range of between about 60 - 64 km (32.4 – 34.6 nm), or a 4.1-km (2.2–nm) CZ annulus when calculated using the Comprehensive Acoustic Simulation System/Gaussian Ray Bundle (CASS/GRAB[142]) model (Weinberg et al., 2001). The deeper LFA source (122 m [400 ft]) has a slightly wider CZ annulus of 5.9 km (3.2 nm), at about 57 - 63 km (30.8 – 34.0 nm) distance from the sound source. Figure E-1 provides the TL plots for

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[137] Sound speed profile (SSP) is a plot of underwater sound speed as a function of water depth.

[138] In underwater acoustics, a zone below the sea surface where sound rays are refracted toward the surface and then reflected. The rays alternately are refracted and reflected along the duct out to relatively long distances from the sound source.

[139] In underwater acoustics, an upward-refracting condition where the sound-speed gradient is positive from the surface all the way to the bottom. In a half channel, sound waves behave as if in a very thick surface duct.

[140] Bottom-limited sound propagation indicates that the sound rays interact with the bottom in some way, particularly through the sound being absorbed and reflected by the bottom, and the sound being refracted through the surface layer of the bottom. A bottom-limited condition is the cause that generates the effect of bottom bounce sound propagation.

[141] GDEM, developed by the U.S. Naval Oceanographic Office, derives vertical profiles of temperature and salinity in 30'x30' latitude-longitude grid elements and employs these data to calculate sound speed profiles. The temperature-salinity profiles are derived from quality-screened data from the Master Oceanographic Observation Data Set maintained by the Fleet Numerical Oceanography Center in Monterey, California.

[142]CASS/GRAB is the Navy standard model for active and passive range-dependent acoustic propagation, reverberation and signal excess. Frequency range is 600 Hz to 100 kHz.

both the MFA and LFA sonars using the source operational characteristics that were identified in Table 4.7-1. For the purpose of this analysis, a nominal 60 km (32.4 nm) range to the CZ annulus for both LFA and MFA was used.

Since the range from each source to its CZ annulus is approximately 60 km (32.4 nm), it was decided to begin by using a separation distance between the sources of 130 km (70.2 nm) in order to ensure that no portion of the LFA or MFA sonar CZ annuli would be overlapping at the outset. An examination of Figure E-1 will show that at 65 km (35 nm) (i.e., the halfway point between the sources when they are 130 km apart) from each source, the MFA transmission has incurred at least 85 dB of TL, while the LFA transmission shows about 78 dB of TL. This is equivalent to maximum received levels at the mid-point of about 150 dB for both MFA and LFA transmissions. Therefore, this starting distance between the sources ensures that all possible modeled locations that could receive about 150 dB or higher have been examined. Additionally, based on the LFA Risk Continuum curve (Figure 4.7-2) all possible sites with greater than 2.5 percent (or 0.025) risk have been examined.

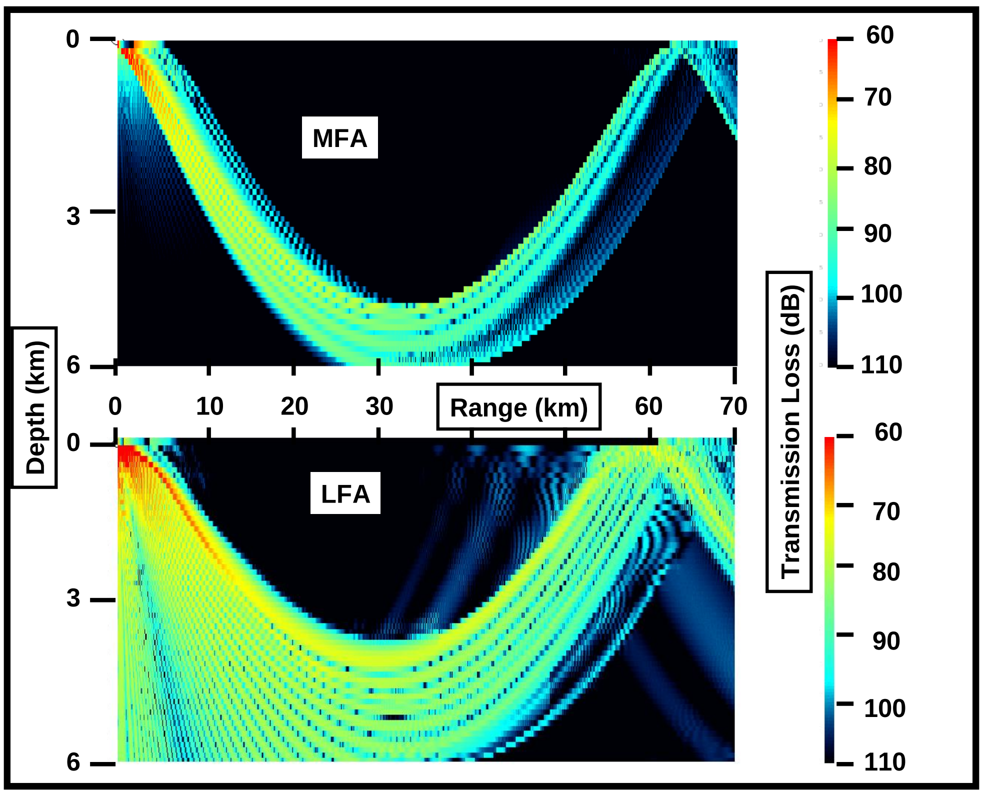

Figure E-1. TL Plots for MFA and LFA Used in the Analysis.

Figure E-2 shows the initial geometric arrangement of the two sources, with the initial range being the maximum distance between the sources (130 km [70.2 nm]). The parametric analysis needed to vary the distance between the sources (i.e., the variable portion of the dimensionless number or the variable parameter) to examine how potential levels of effects on marine mammals change as a function of that parameter. Since the critical acoustic parameter for this CZ propagation case has been identified and fixed at 60 km (32.4 nm), the only method to adjust or vary the dimensionless parameter of equation (1) was to change the distance between the sound sources. This is represented in Figure E-2 by the movement of the MFA sonar to the left (i.e., decreasing the range between the sources) for each subsequent run of the underwater acoustic propagation model. Before this modeling could be accomplished, some additional modeling decisions were necessary.

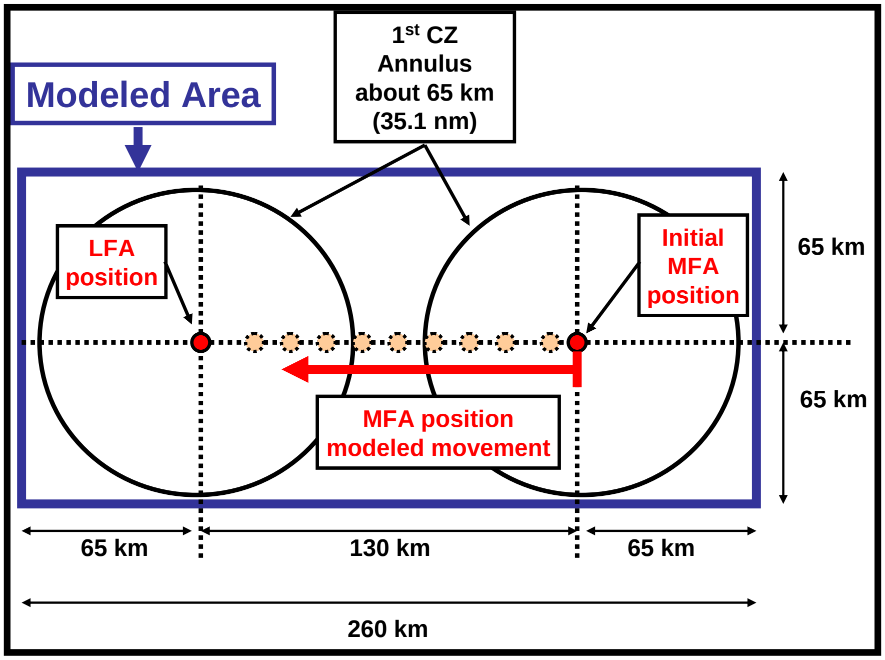

Figure E-2. Geometry of the Modeled Area Used for the Parametric Analysis.

E-2.2 ADDITIONAL ANALYSES ASSUMPTIONS

Two additional general decisions needed to be made in order to complete the parametric analysis. The first was the selection of the acoustic propagation modeling resolution (i.e., the size of individual increments of water space to be analyzed) and the related need to identify the step increment for the ranges between the sound sources (i.e., how many distances between the sound sources would be examined). The second decision was to identify a metric for the potential changes to the effects on marine mammals.

E-2.2.1 Modeling Resolution and Step Sizes

For this analysis, a resolution of 50 m (164 ft) in the X and Y directions and 100 m (328 ft) for depth (Z direction) was used for both the acoustic model and the gridding of receiver locations in the analysis volume. This allowed the examination of over 6.3 million RL locations during each run (i.e., range step) of the analysis. These values are a reasonable compromise that allowed adequate resolution of the acoustic sound fields and timely completion of the calculations of the overlapping sound fields.

A preliminary analysis showed little variation in the average risk for each modeled location for a range step of 0.1 km (0.054 nm) (i.e., the amount of distance between the LFA and MFA sources changed each time the model was rerun). There was concern that a range step of 1.0 km (0.54 nm) might miss details of the results. Thus, a compromise of 0.5 km (0.27 nm) was decided on as the appropriate range step size.

E-2.2.2 Effects Metric

Prior to deciding on the effects metric, some care must be taken to correctly identify how these two different sonar transmissions can add to each other at the receiver locations modeled in the parametric analysis.

Figure E-3 illustrates the following points. The combined transmission of an LFA and MFA sonar has a maximum addition of 3 dB if the RLs of the two transmissions are equal, but as one transmission grows stronger than the other because of the receiver location and the TL of the transmissions to that location, the contribution of the weaker transmission decreases accordingly. Thus if the weaker transmission is 5 dB less than the stronger, the additional energy only adds 1.2 dB, and by the time the difference is 10 dB, the addition is only about 0.4 dB. Therefore, for each transmission to contribute significantly (i.e., greater than 0.4 dB) when combined, the RLs for the transmissions must be within about 10 dB of each other.

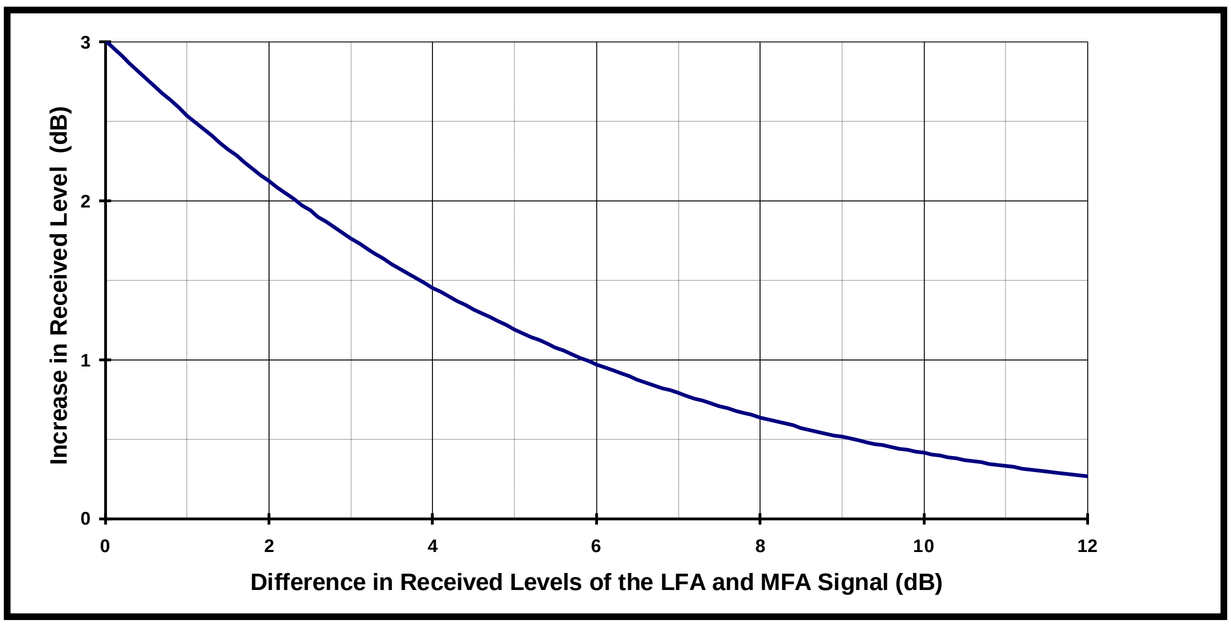

Figure E-3. Net increase in received level of the combined transmission, based on the difference in individual transmissions at these frequencies

For the purposes of this transmission addition discussion, it was assumed that the transmissions arrived at the receiver location at the same time. As discussed in Subchapter 4.7.4, however, this kind of exact overlap of LFA and MFA sonar sound would only occur at each receiver location (i.e., modeled grid location) for approximately 2 seconds every 10 minutes or so, due to the nominal 60-second duration of the LFA sonar transmission approximately every 10 minutes, and the nominal one-second MFA transmission every 30 seconds or so. The period of overlapping transmissions (0.32 percent of the time that both sonars are operating) is the only time and place that could possibly contribute to the combined effects (i.e., other times and locations will only have one transmission present at the most). Hence, the model was designed to ignore the transmission travel times and assume that for each receiver location the two transmissions arrived "simultaneously" after incurring the appropriate TL as their sound propagated to that location.

Because it is impossible to know what marine mammals, if any, are present at the time and place when the LFA and MFA sonar transmissions overlap, it was assumed that all the receiver locations have an equal number of marine mammals. These two assumptions (i.e., that the transmissions arrive simultaneously at all locations, and that all locations have an equal number of marine mammals) further facilitated the examination of potential effects from: 1) the LFA sonar alone; 2) the MFA sonar alone; and 3) the combined LFA and MFA sonars operating concurrently.

The simplest way to identify a combined effects metric that includes the modeling discussed above and allows for the application of the SURTASS LFA sonar risk continuum is to apply that risk continuum to each modeled location, and then sum the total risk for the entire modeled water volume. This was done for the three transmission reception cases (i.e., the LFA sonar transmission alone, the MFA sonar transmission alone, and the combined LFA and MFA sonar transmissions). The effects from the two independent cases (i.e., the LFA sonar transmission alone, the MFA sonar transmission alone) were then added and compared to the combined case, for the modeled separation range between the two sources. Then the sources were moved closer together based on the 0.5-km (0.27-nm) range step size, and the model was rerun again for the new source range difference. The process was repeated multiple times to create Figure E-4, which graphically represents the percent change in risk per modeled location.

E-2.2.3 Discussion of the Parametric Analysis Results

First, as reflected in Figure E-4, all of the results of the analyses show a change in risk percentage of zero or less. In other words, there is actually less risk where the MFA and LFA sonar transmissions overlap than there is from simply combining the risk from the transmissions from the sonars operating independently, and the larger the volume of the overlapping transmissions (i.e., when the sources are less than 10 km apart), the greater the reduction in risk. This counter-intuitive result is discussed further in Section E-2.4.

The second message from Figure E-4 is the correlation between the "dips" in the curves and real-world conditions. As the labels in the figure explain, the three black arrows correspond to the particular configurations of the sonars and the CZ annuli, as shown in Figures E-5, E-6, and E-7. Note that when the sources' CZs intersect, the dark green areas indicate where there would be an expected increase in Level B volumes.

Essentially, the three "dips" in the separation ranges shown in Figure E-4 reinforce the conclusion that as more of the volume has overlapping transmissions of similar received level, the overall risk is decreased. By covering the full gamut of MFA/LFA sonar separation distances where the parametric analysis indicated that there might be changes to the risk, the realistic combinations of the critical parameter (i.e., sonar separation range) were examined and found to have no increase (and often exhibit a decrease) in risk when the sonars operate concurrently, as compared to when they operate independently. The analysis has covered all realistic configurations of the MFA and LFA sonars for the CZ case revealing that, regardless of what the source ship tracks and speeds are, the change in risk between MFA and LFA sonars operating independently as opposed to concurrently will be zero or less. Thus, there is no possibility of increased effects from the addition of LFA and MFA sonar transmissions when operating concurrently, beyond the risk associated with the systems operating independently.

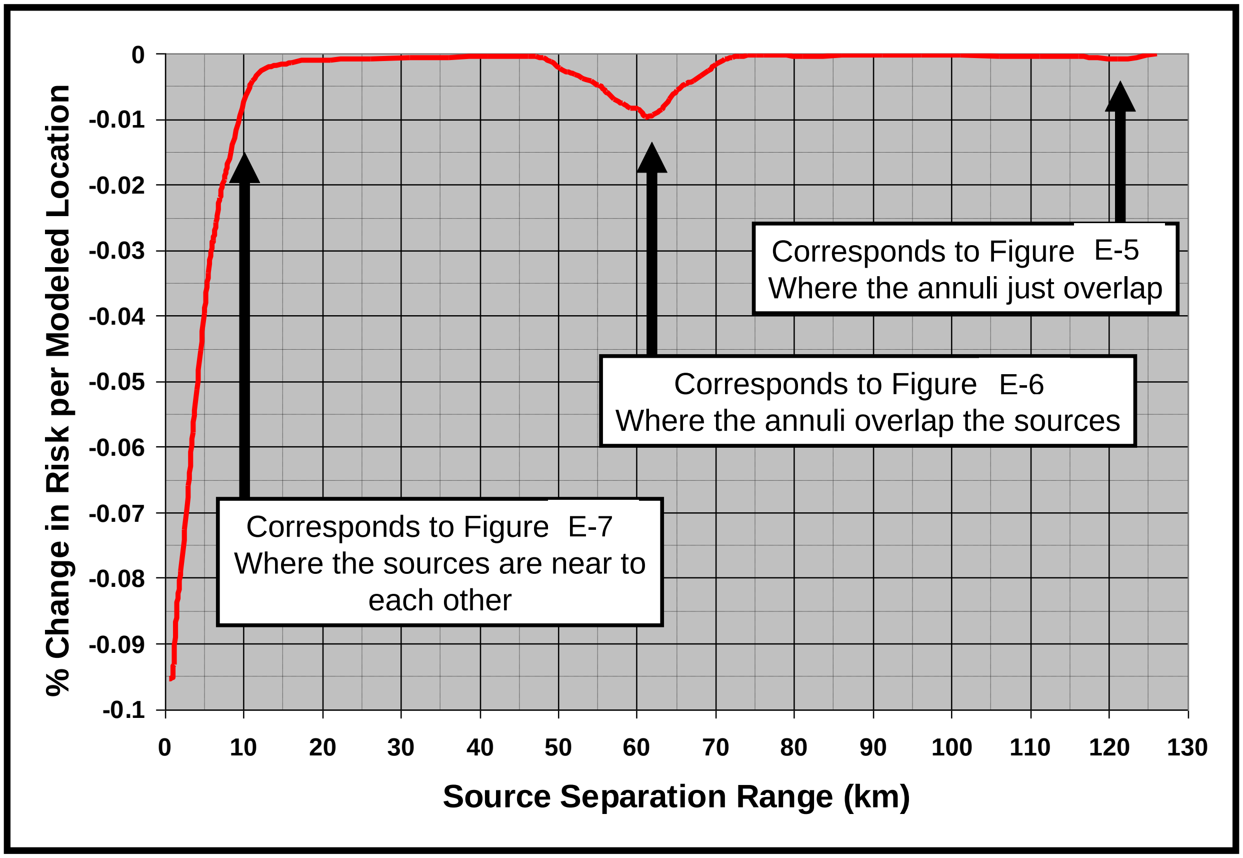

Figure E-4. Percent Change in Risk as a Function of Source Separation Distance.

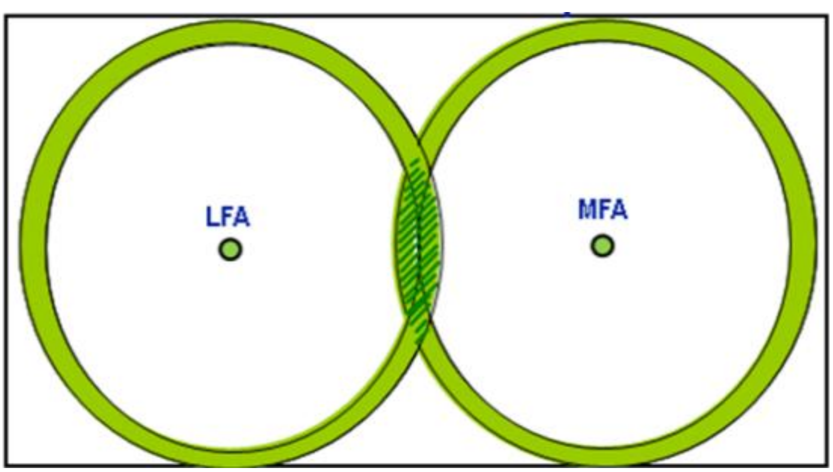

Figure E-5. Source Separation Distance of About 120 km, Where the CZ Annuli Are Just Overlapping.

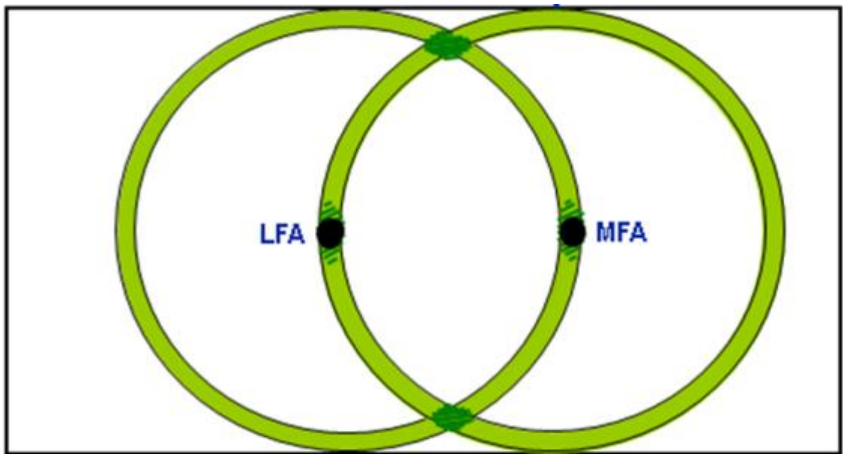

Figure E-6. Source Separation Distance of About 60 km,

Where the CZ Annuli Are Just Overlapping the LFA and MFA Sources.

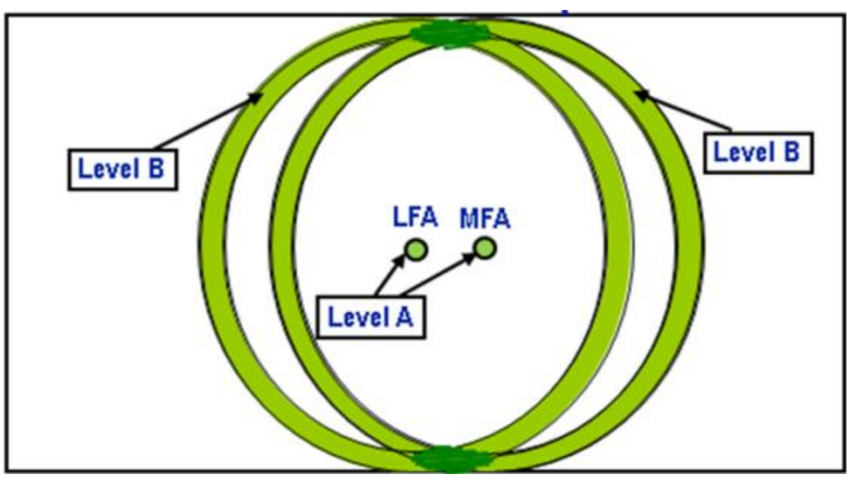

Figure E-7. Source Separation Distance of 10 km or Less,

Where the LFA and MFA Sources are in Proximity.

Essentially, the three “dips” in the separation ranges shown in Figure E-4 reinforce the conclusion that as more of the volume has overlapping transmissions of similar received level, the overall risk is decreased. By covering the full gamut of MFA/LFA sonar separation distances where the parametric analysis indicated that there might be changes to the risk, the realistic combinations of the critical parameter (i.e., sonar separation range) were examined and found to have no increase (and often exhibit a decrease) in risk when the sonars operate concurrently, as compared to when they operate independently. The analysis has covered all realistic configurations of the MFA and LFA sonars for the CZ case revealing that, regardless of what the source ship tracks and speeds are, the change in risk between MFA and LFA sonars operating independently as opposed to concurrently will be zero or less. Thus, there is no possibility of increased effects from the addition of LFA and MFA sonar transmissions when operating concurrently, beyond the risk associated with the systems operating independently.

Further, even though this analysis was conducted for the CZ case, the results can be considered to be germane to the other two deep-water acoustic propagation modes that may be encountered in the North Pacific Ocean and other potential SURTASS LFA sonar operating areas. For example, the ducted and half-channel propagation situations produce a RL volume originating near the sources and extending outward undergoing cylindrical spreading, which has less TL than the typical spherical spreading expected at these ranges. This volume will therefore have higher RLs for both the LFA and MFA sonar transmissions than the CZ case above. This greater RL volume would translate to greater “dips” or reductions in average risk for modeled locations. Similarly, the bottom-limited case (i.e., where the transmitted sound rays reflect off the ocean bottom before they refract or bend upward as they would in a CZ) would also have more RL volume with strong received transmissions, because the bottom reflections would ensonify a greater portion of the volume of the ocean than just that volume in the CZ path. Thus, this case would also have higher RLs for both the LFA and MFA sonar transmissions and corresponding decreases in risk for MFA/LFA sonar concurrent operations.

E-2.2.4 Explanation of the Results of the Parametric Analysis

The risk decreases when the LFA and MFA sonar’s CZ annuli overlap with each other, or with the sources themselves, because in many locations throughout the RL volume of the two overlapping MFA/LFA sonar sound fields, one sonar transmission dominates or overshadows the other transmission, and minimizes its contribution to the total risk experienced at each modeled location. This risk value is slightly larger than either of the individual risk values viewed separately, but it is less than the risk of the two independent risk values added together. Indeed, for most of the modeled locations throughout the modeled volume, one of two cases occurs: a) one of the RLs is significantly higher (i.e., greater than 10 dB) than the other RL; or b) both RLs are below the 120-dB RL of the risk continuum where risk is considered zero.

As shown in Figure E-8, for case (a) the higher RL dominates in both the combined RL value and in the contribution of its individual risk; so, the difference between the “combined risk” (dark blue [source A] and yellow [source B]) and their “combined energy” (green case) ends up being negligible. Only when RL locations have similar or close RLs for sources A and B (i.e., in case [b]) do slightly larger decreases in risk occur to the total risk throughout the sound field (see Figure E-9). As the number of these locations increases (i.e., when the CZ annuli overlap), so does the change in total risk become noticeable, as in Figure E-4. However, it never results in an increase in the risk experienced from the addition of independent risks from the MFA and LFA sonars.

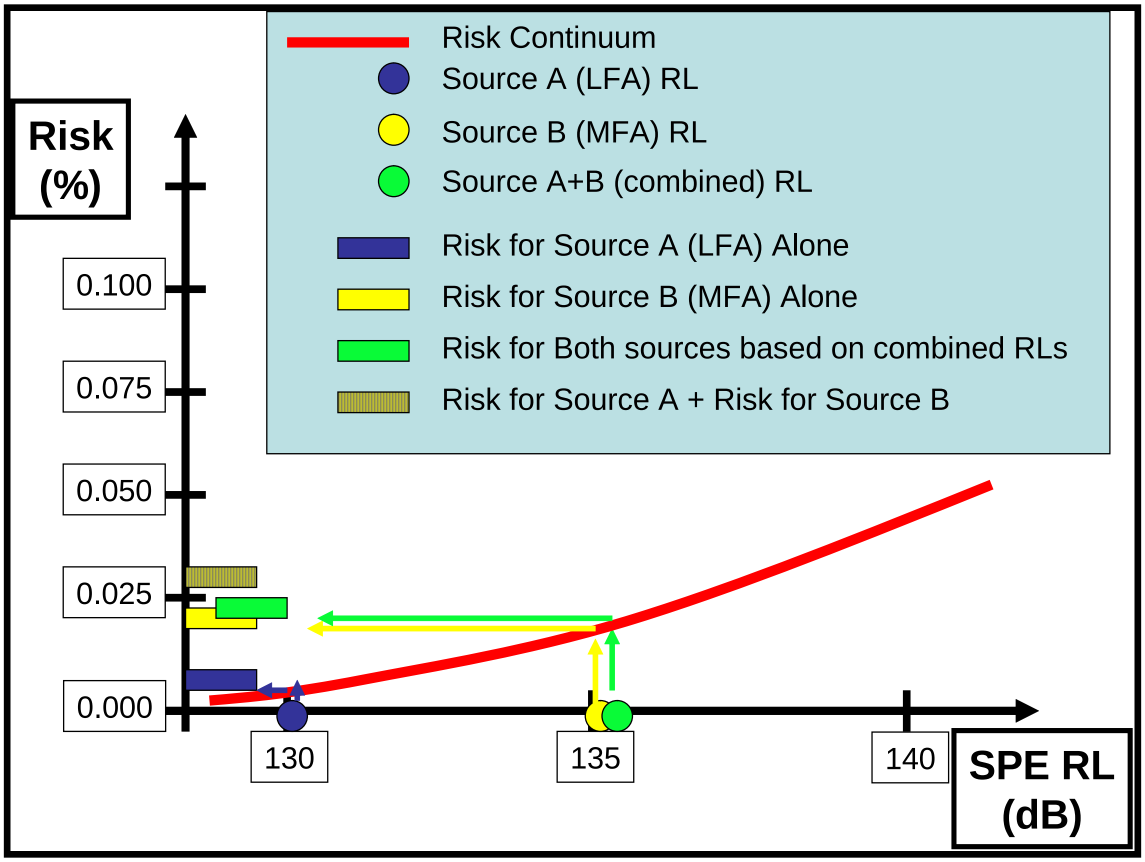

Figure E-8. Graphic Representation of the Calculation for Combined Risk for Two Separate Sources for the Case of Dissimilar Receive Levels.

Figure E-9 illustrates a case where the two RLs are about equal. Here the two RLs for sources A and B, respectively, are shown for a RL location where both RLs are about 135 dB (shown as the dark blue and yellow circles, respectively). The individual risk for each of these single RLs, if treated separately, is shown as the dark blue and yellow rectangles on the vertical or "risk" axis of the figure (assume 0.020 for source A and 0.023 for source B). If the energy for the two RLs is combined, the resulting RL (shown as the green circle) is a maximum of approximately 3 dB higher than the larger of RLs of source A or source B (i.e., 3 dB higher than RL B which is 135 dB--thus it is 138 dB). The corresponding risk for the combined energy case is the green rectangle—at about 0.035 on the vertical axis.

By contrast, a simple addition of the risk for the two individual sources (i.e., the dark blue and yellow rectangles), shown as a dark blue and yellow striped rectangle, carries a risk value of approximately 0.043 (i.e., the risk from A and B separately added: 0.020 + 0.023 = 0.043). The risk of the combined transmissions (green) is therefore less than that of the two transmissions treated separately, specifically about -0.008 less (0.035 – 0.043 = – 0.008).

In the parametric analysis, this slight difference in risk can occur at many points throughout the overlapping sound fields of the modeled RL volume, with each sonar transmission. It is the addition of reduced risk provided by many modeled locations that slowly accumulates and results in the overall risk reduction that appears in Figure E-4.

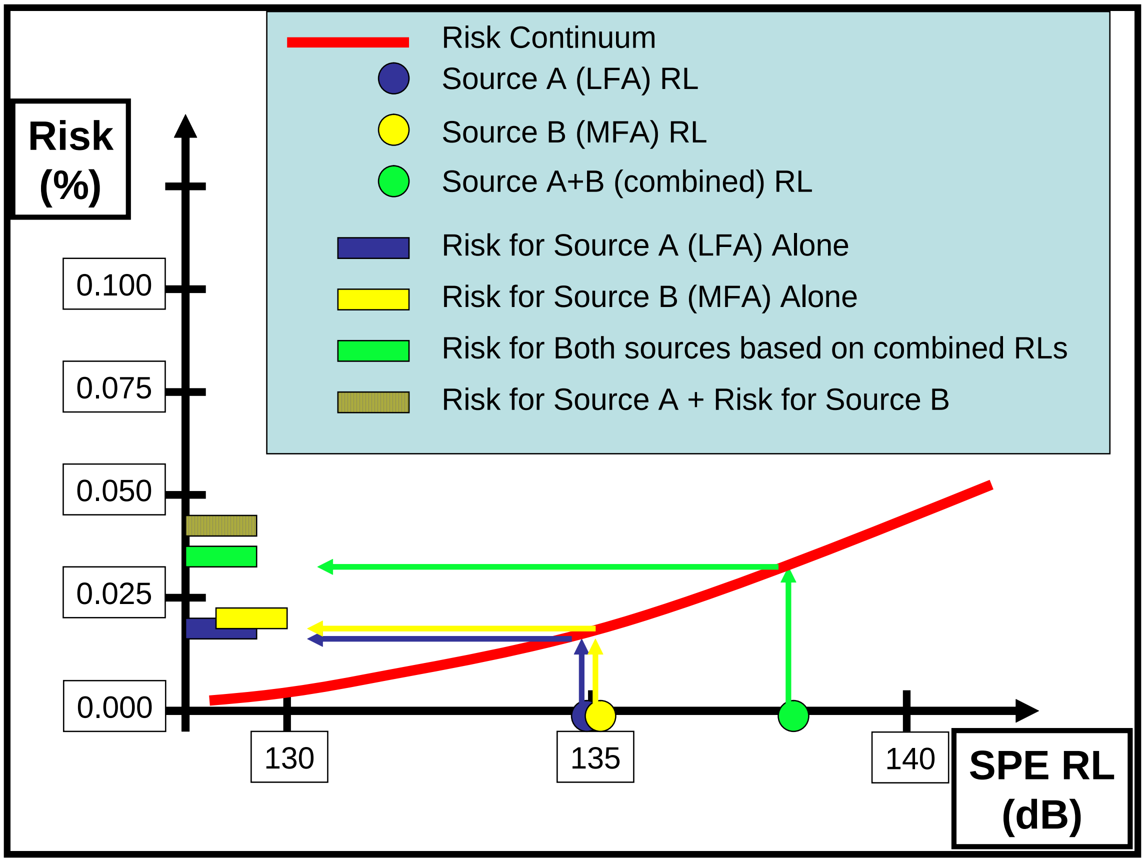

Figure E-9. Graphic Representation of the Calculation for Combined Risk for Two Separate Sources for the Case of Similar Receive Levels.

In most real-world cases the two received transmissions will not be equal (i.e., the blue and yellow circles will not be at about the same level); in fact, one transmission may be as much as 10 dB or so below the other but only contribute slightly to the overall risk. An example of a case where the difference in RL is 5 dB is shown in Figure E-8, where the green circle, representing the combined RL, while slightly higher than the larger of the yellow and blue circles, is significantly closer to the larger of those two than was the case in Figure E-9. In this example, the individual risk values are 0.006 for source A (blue circle) and 0.022 for source B (yellow circle), with the combined (green rectangle) risk being 0.024, and the summed risk being 0.028. Thus, the change or decrease in risk for this case is about 0.004 (i.e., 0.024 – 0.028 = –0.004). This is about half of the risk reduction for the case where the RLs are nearly equal.

E-2.2.5 Parametric Analysis Summary

In summary, the results of this parametric analysis, which utilized the SURTASS LFA sonar risk continuum approach, show that the potential risk for Level B harassment from MFA and LFA sonar concurrent operations is not greater than the sum of the individual risks from each of the MFA and LFA sonar sources operating independently.

E-3.0 ACOUSTIC INTEGRATION MODEL (AIM) ANALYSIS

The model analysis presented here is an attempt to create a simulation of a representative concurrent operation with one LFA sonar and one MFA sonar. Actual waypoints representing plausible ship courses are input into the model, as are the source characteristics of each vessel (see Table E-1). Each modeled vessel produces a sonar ping according to the programmed sonar plan for the vessel. A population of representative marine mammals is placed in the simulation around the vessels. These simulated animals, referred to as "animats," are programmed to move in four dimensions, with movement parameters derived from actual animals. The acoustic propagation from the ships to each animat is modeled with the Ocean and Atmospheric Master Library (OAML[143])-approved Parabolic Equation (PE[144]) model (Zingareli et al., 1999) for the LFA ship and the ray-based BELLHOP[145] model (Porter, 1992) for the MFA source (because BELLHOP is better suited to the acoustic parameters of MF sources than PE). The received level (RL) at each animat can therefore be predicted. These predicted RLs are then analyzed using the standard methods as described in Subchapter 4.4.1 of the SURTASS LFA Sonar Final SEIS (Department of the Navy (DoN), 2007). One additional calculation is needed to sum MFA and LFA transmissions that arrive simultaneously, which is discussed in Section E.3.2 below.[146]

Table E-1. Source Characteristics used for AIM modeling.

Source	**Low-Frequency Active Sonar**	**Mid-Frequency Active Sonar**
Source Level	Typical Operational	Typical Operational
Frequency	250 Hz	3500 Hz
Duty Cycle	60 second transmission every ten minutes	1 second transmission every 30 seconds
Beam Pattern	Normal LFA beam pattern	Normal omni-directional transmission, vertically beamformed

[143] The Chief of Naval Operations (CNO) established OAML in 1984. The OAML suite consists of Navy-standard core-models, algorithms and databases that support the Department of the Navy, Department of Defense, research and development laboratories and Joint and NATO activities.

[144] Parabolic Equation (PE) 5.0 is a robust and capable model that incorporates one of the fastest and most accurate acoustic models, the Range-dependent Acoustic Model (RAM). For the most part, both the ocean acoustics R&D community and the Navy operational community are using the same PE model.

[145] BELLHOP computes underwater acoustic transmission paths via beam (ray) tracing. Ray tracing is a method for calculating the path of sonar beams through water with regions of varying propagation conditions, absorption characteristics, and reflecting surfaces. Under these circumstances, sonar beam may bend, change direction, or reflect off the water surface or seafloor, complicating analysis. Ray tracing solves the problem by repeatedly advancing idealized narrow beams called *rays* through the water by discrete amounts. Simple problems can be analyzed by propagating a few rays using simple mathematics. More detailed analyses can be performed by using a computer to propagate many rays.

E-3.1 DESCRIPTION OF AIM

The concern for underwater acoustic impacts to marine mammals has been growing since the 1990s. Because of the complexity of underwater acoustic propagation, acoustic exposure of marine animals is a function of the animal's depth as much as its range from the source. Therefore, the accurate prediction of acoustic exposure of free-ranging animals requires the consideration of animal movement as well as physical environmental conditions. The Acoustic Integration Model (AIM) was developed to address this requirement. Furthermore, any impact analysis model needs to be able to fully address: 1) changing and variable acoustic thresholds; 2) the scarcity of data on marine mammal densities, distribution and their behavioral responses to underwater sound; 3) constantly improving and expanding environmental data bases and propagation model capabilities; and 4) the requirement from both federal regulators and the public to use the best available science for any impact analysis process. AIM has been at the forefront of these issues and has attempted to properly address them since its development in the late 1990s. It was first applied to the U.S. Navy's SURTASS LFA Sonar EIS/OEIS (DoN, 2001), which was the first EIS prepared for a Navy operational system. Since then it has been used for other acoustic sources, including seismic profilers, underwater explosives, over-water sonic booms, and numerous active sonar applications. Today it is an open architecture coalition of candidate models and databases. The component of AIM that remains actively involved in all AIM executions is the animat movement engine, which creates the sound sources and animats of interest, moves them in 3D in the ocean volume, and facilitates tracking the estimated sound exposure on each modeled marine mammal.

Because the exact underwater positions of sources and receivers cannot be known, multiple runs of realistic predictions are used to provide statistical validity. The movement and/or behavioral patterns of sources and receivers can be known, and these data are incorporated into the model. Accurate representation of the movements of sources and receivers is necessary for realistic predictions. Each source and/or receiver is modeled via the animat concept. Each animat has parameters that control its speed and direction in three dimensions. Thus, it is possible to recreate the type of diving pattern that an animal shows in the real world. Furthermore, the movement of the animat can be programmed to respond to environmental factors, such as water depth and sound level. In this way, species that normally inhabit specific environments can be constrained in the model to stay within that habitat.

Once the behavior of the animats has been programmed, the model is run. AIM proceeds forward in time, with all features following the same master clock; the source produces a sound, the transmitted sound level at all ranges and depths is calculated using the propagation loss model, the range and depth of each animat at that time is noted and the respective RL for that animat is noted and retained with that animat's record. Then each animat and the source move ahead in time to the next source transmission, and the process is repeated. This continues until all source transmissions have been completed. After all the programmed runs are complete, each animat's full record of exposure levels is analyzed and a risk assessment is assigned, both to individual animals, as well as the resident population.

E-3.2 DESCRIPTION OF THE MODELING EFFORT

In this analysis, an approach similar to that used for estimating the potential environmental effects from real-world operations of SURTASS LFA sonar was used. Courses and speeds for both LFA and MFA vessels, and the LFA and MFA sonar acoustic characteristics were input into AIM. Each of three potential operational scenarios was then populated with marine mammals around the LFA and MFA vessels (see Sections E-3.2.3, E-3.2.4 and E-3.2.5 below). The model was then run to predict the sound source exposure history for individual animals in each MFA/LFA concurrent operations exposure scenarios.

E-3.2.1 Selection of the Scenarios to be Modeled

The ship movement scenarios selected were designed to address both intentional (clearing) and incidental (closing or parallel courses) interactions between LFA and MFA vessels. The clearing exercise scenario was designed as a possible sweep of an MFA ship around an LFA ship to detect any nearby submarines. The parallel course scenario is set up so that the LFA and MFA source ships start at approximately two CZs apart, with animals between them. The overtaking scenario starts with the MFA source ship approximately two CZs behind the LFA source ship, and then overtaking the LFA ship because of its greater speed. This scenario places the source ships much closer than would ever occur in actual LFA/MFA concurrent operations, but attempts to place an upper bound on potential risk.

E-3.2.2 Technical Approach

To estimate the acoustic exposure that an animal is likely to receive while the sources are transmitting, the movement of animals and the acoustic fields to which they would be exposed are modeled. The sound fields around each source are estimated based on details of the proposed acoustic sources using the Navy's standard PE model 5.0 for low-frequency sources (SURTASS LFA sonar) to a range of 150 km (81 nm), and BELLHOP for mid-frequency sources (AN/SQS-53C) to a range of 100 km (54 nm). AIM is used to simulate the acoustic exposure for each marine mammal species from the nominal transmissions of the MFA and LFA acoustic sources. Analyses were performed using generic animal species behavior, and each model run involved two 5-hour simulations (one for LFA and one for MFA), with animal 3D movement replicated.

AIM Input Parameters

- Animat species was a generic baleen whale, based on blue and fin whale movement parameters.
- Animat density = 0.1 animats/sq km (this is the model density)
- Animal density = 0.001 animals/sq km (this is predicted density of real animals)
- MFA ship speed 18.5 km/hr (10 kt)
- LFA ship speed 6 km/hr (3.2 kt)
- Feller risk continuum curve parameters:
    - Basement (B) = 120 dB (same as baseline LFA case)
    - Transition Point (K) = 45 dB (same as baseline LFA case)
    - Slope Parameter (A) = 10 (as in the single LFA, single MFA, or combined effects LFA & MFA analysis)

To estimate the risk of harassment from each acoustic source, the individual acoustic exposures an animal receives were converted to single ping equivalent (SPE), using established SURTASS LFA sonar procedures (i.e., 5LogN, where N = number of exposures). This SPE is input into the SURTASS LFA sonar risk continuum to estimate Level B harassment (Figure 4.7-2). The SPE RLs are then evaluated for each source three ways: 1) separately; 2) additive (i.e., the two separate values added together); and 3) combined by summing the pressure of the two waveforms, a procedure that accounts for difference in frequency between the two transmissions.

Three nominal operational scenarios were analyzed:

- A "clearing" exercise scenario, analyzed for both CZ and surface duct underwater sound propagation;
- A "parallel courses" exercise scenario, with the LFA and MFA vessels two CZs apart, and the animals between the vessels, analyzed for both CZ and surface duct underwater sound propagation; and
- An "overtaking" exercise scenario, where the MFA vessel starts two CZs behind the LFA vessel, and by its greater speed, overtakes and passes the LFA vessel, analyzed for both CZ and surface duct underwater sound propagation.

The following AIM analyses could not be done for the whole world, so the overlapping SURTASS LFA sonar and MFA sonar operating areas have been localized to areas of the North Pacific Ocean for convergence zone (CZ) sound propagation conditions and the Gulf of Alaska for duct sound propagation conditions. The North Pacific should be considered the most probable scenario for concurrent SURTASS LFA and MFA sonar operations. Analysis of other oceanic areas where CZ propagation is most prominent would be expected to yield negligible differences in results from those presented here. For the duct sound propagation scenarios, the Gulf of Alaska region should be considered the most probable area for concurrent SURTASS LFA and MFA sonar operations where duct sound propagation conditions would exist. Likewise, analysis of other oceanic areas where duct propagation could occur would be expected to yield negligible differences from those presented here.

Doing this for specific cases (e.g., MFA and LFA source ships one and two CZs apart) will also allow the testing of the fidelity of the parametric analytic approach by using a dynamic case with 3D animal movement.

It should be noted that the risk values presented here do not take into account any effect of the mitigation measures required for either SURTASS LFA or MFA sonar, which would lessen any risk analyzed here.

E-3.2.3 "Clearing" Exercise Scenario

Figure E-10 illustrates an MFA vessel "clearing" all sectors around the LFA vessel, starting in the rear port quadrant, moving forward, then starboard, then aft, to check all quadrants for possible submarines. Note that each square is approximately 9 km (5 nm) on a side.

The results from the AIM model runs for the "clearing" exercise scenario, for both a CZ and duct sound propagation environment, are presented below[147].

[147] Mathematical values shown to the 4th decimal place are for illustrative purposes, and are necessary to show the differences among the calculated values.

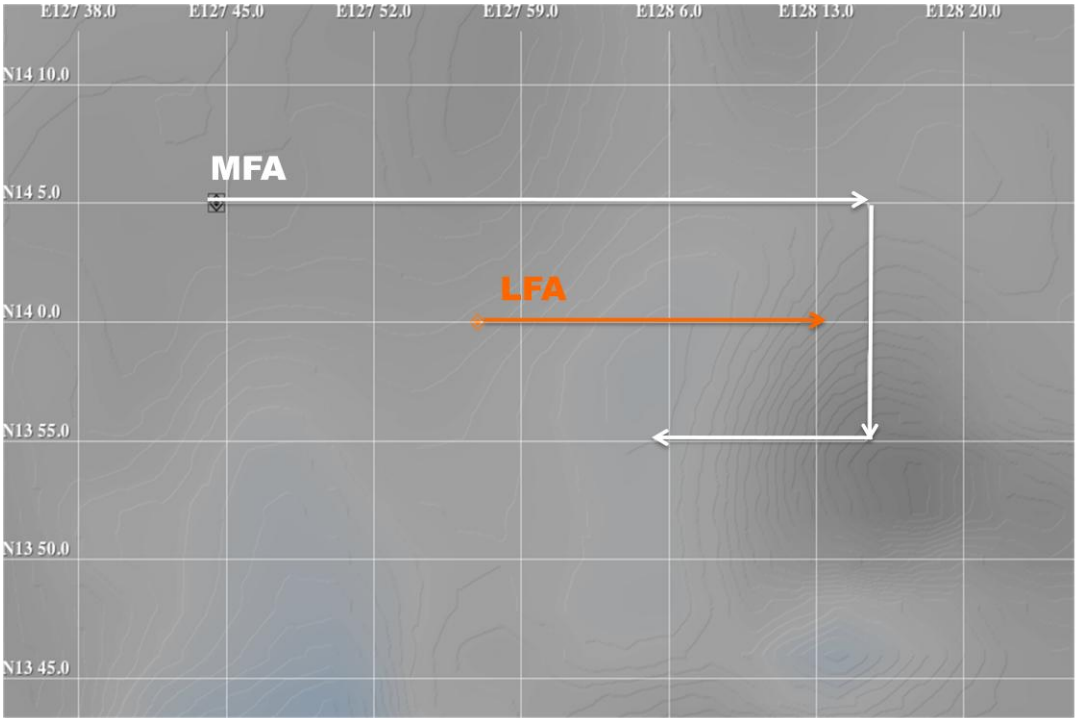

Figure E-10. Geographical set-up for model analysis—"clearing" exercise scenario.

Acoustic Analysis--"Clearing" Exercise Scenario Results (CZ Sound Propagation)
Total risk for 1919 animats, as derived from the SURTASS LFA sonar risk continuum: • LFA risk alone = 0.0716 • MFA risk alone = 0.0626
Additive risk = 0.1342 (LFA risk alone + MFA risk alone)
Combined risk (calculated) for concurrent LFA and MFA sonar operations considering frequency and duty cycle differences = 0.1340
Risk for concurrent LFA and MFA sonar operations = difference between additive and combined risk values (combined minus additive) = 0.1340 – 0.1342 = - 0.0002
Conclusion: Result of concurrent MFA/LFA sonar operations is zero increase in risk, over that from summing the risk of the two sources operating independently.

Acoustic Analysis—“Clearing” Exercise Scenario Results (Duct Sound Propagation)
Total risk for 1349 animats as derived from the SURTASS LFA sonar risk continuum: • LFA risk alone = 0.07893 • MFA risk alone = 0.07971
Additive risk = 0.1586 (LFA risk alone + MFA risk alone)
Combined risk (calculated) for concurrent LFA and MFA sonar operations considering frequency and duty cycle differences = 0.1448
Risk for concurrent LFA and MFA sonar operations = difference between additive and combined risk values (combined minus additive) = 0.1448 – 0.1586 = -0.0138
Conclusion: Result of concurrent MFA/LFA sonar operations is zero increase in risk, over that from summing the risk of the two sources operating independently.

E-3.2.4 “Parallel Course” Exercise Scenario

The results from the AIM model runs for the “parallel course” exercise scenario (Figure E-11), for both a CZ and duct sound propagation environment, are presented below.

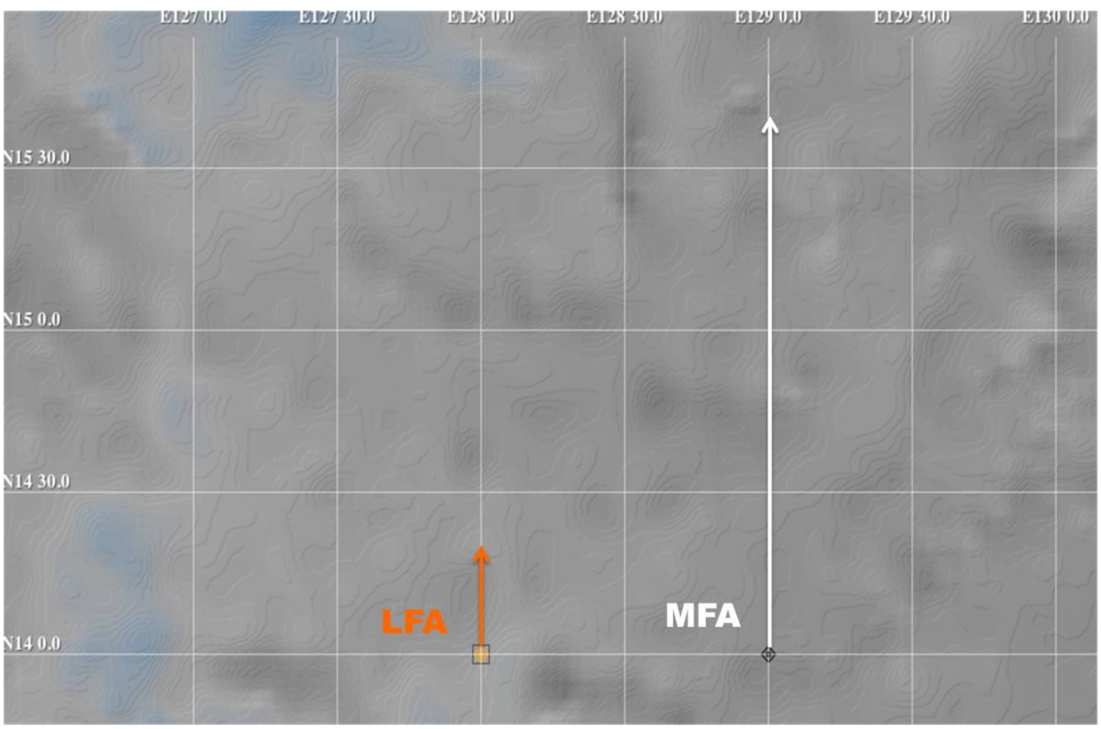

Figure E-11. Geographical set-up for model analysis—“parallel course” exercise scenario.

Acoustic Analysis—“Parallel Course” Exercise Scenario Results (CZ Sound Propagation)
Total risk for 2532 animats as derived from the SURTASS LFA sonar risk continuum: • LFA risk alone = 0.0666 • MFA risk alone = 0.0954
Additive risk = 0.1620 (LFA risk alone + MFA risk alone)
Combined risk (calculated) for concurrent LFA and MFA sonar operations considering frequency and duty cycle differences = 0.1613
Risk for concurrent LFA and MFA sonar operations = difference between additive and combined risk values (combined minus additive) = 0.1613 – 0.1620 = - 0.0007
Conclusion: Result of concurrent MFA/LFA sonar operations is zero increase in risk, over that from summing the risk of the two sources operating independently.

Acoustic Analysis—“Parallel Course” Exercise Scenario Results (Duct Sound Propagation)
Total risk for 7839 animats as derived from the SURTASS LFA sonar risk continuum: LFA risk alone = 0.9195 MFA risk alone = 0.2659
Additive risk = 1.1854 (LFA risk alone + MFA risk alone)
Combined risk (calculated) for concurrent LFA and MFA sonar operations considering frequency and duty cycle differences = 1.1002
Risk for concurrent LFA and MFA sonar operations = difference between additive and combined risk values (combined minus additive) = 1.1002 - 1.1854 = -0.0852
Conclusion: Result of concurrent MFA/LFA sonar operations is zero increase in risk, over that from summing the risk of the two sources operating independently.

E-3.2.5 “Overtaking” Exercise Scenario

The results from the AIM model runs for the “overtaking” exercise scenario (Figure E-12), for both a CZ and duct environment, are presented below.

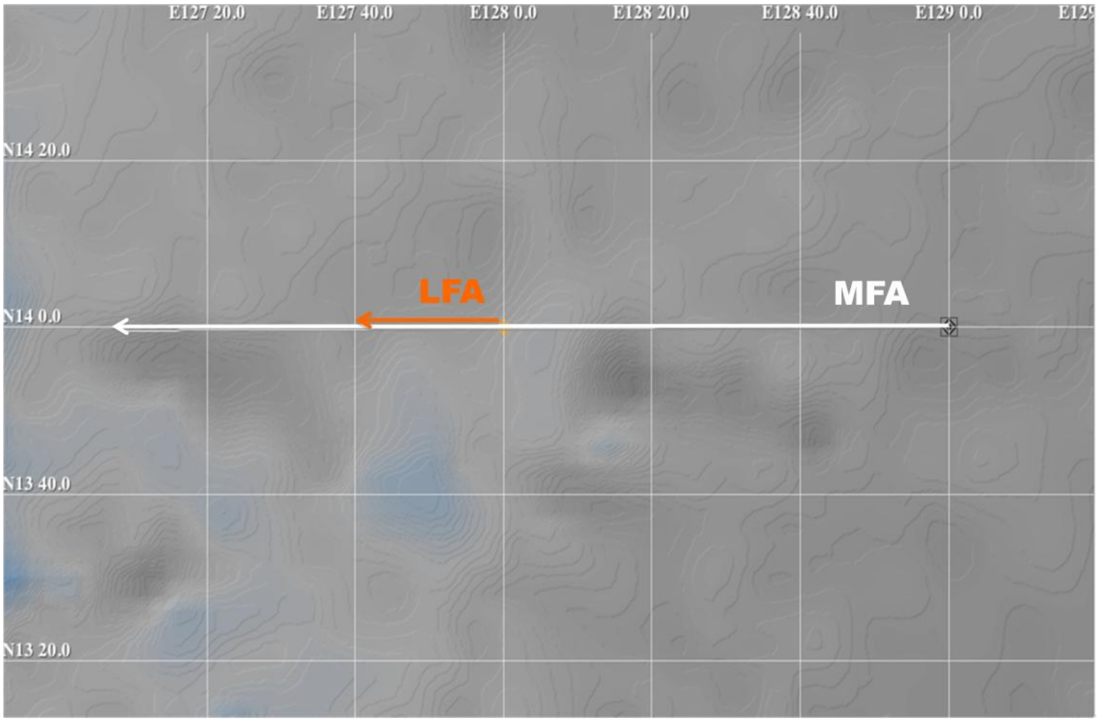

Figure E-12. Geographical set-up for model analysis—“overtaking” exercise scenario.

Acoustic Analysis—“Overtaking Course” Exercise Scenario Results (CZ Sound Propagation)
Total risk for 3024 animats as derived from the SURTASS LFA sonar risk continuum: • LFA risk alone = 0.0669 • MFA risk alone = 0.0948
Additive risk = 0.1617 (LFA risk alone + MFA risk alone)
Combined risk (calculated) for concurrent LFA and MFA sonar operations considering frequency and duty cycle differences = 0.1557
Risk for concurrent LFA and MFA sonar operations = difference between combined and additive risk values (combined minus additive) = 0.1557 – 0.1617 = - 0.0060
Conclusion: Result of concurrent MFA/LFA sonar operations is zero increase in risk, over that from summing the risk of the two sources operating independently.

Acoustic Analysis—"Overtaking Course" Exercise Scenario Results (Duct Sound Propagation)
Total risk for 5340 animats as derived from the SURTASS LFA sonar risk continuum: • LFA risk alone = 0.9623 • MFA risk alone = 0.2235
Additive risk = 1.1858 (LFA risk alone + MFA risk alone)
Combined risk (calculated) for concurrent LFA and MFA sonar operations considering frequency and duty cycle differences = 1.0263
Risk for concurrent LFA and MFA sonar operations = difference between additive and combined risk values (combined minus additive) = 1.0263 - 1.1858 = -0.1595
Conclusion: Result of concurrent MFA/LFA sonar operations is zero increase in risk, over that from summing the risk of the two sources operating independently.

E-3.3 FINDINGS OF AIM ANALYSIS

In all six modeled scenarios, this model analysis, which utilizes AIM and the SURTASS LFA sonar risk continuum approach, shows that the concurrent operation of the LFA and MFA sources provided a slightly lower risk than the combined risk of each source operating independently. In summary, the relative differences between additive risk and combined risk for concurrent MFA and LFA operations range from – 0.0002 to – 0.0060 for CZ sound propagation conditions, and from – 0.0138 to – 0.1595 for duct sound propagation conditions. However, the relative differences between the two analyses are very small and for many cases are essentially zero. Given that the sequential operation analysis (i.e., separate analysis) produces the slightly larger risk values, summing the individual risk values of the two sources operating independently is the more conservative approach.

E-4 CONCLUSION

Two separate analytic approaches (parametric analysis and Acoustic Integration Model analysis), performed independently, have concluded that there is no potential increase in risk for Level B harassment from concurrent MFA and LFA sonar operations, over that from summing the risk of the two sources operating independently.

E-5 REFERENCES

Avallone, Eugene A and Theodore Baumeister III (editors) (1987) Marks' Standard Handbook for Mechanical Engineers, Ninth Edition, McGraw-Hill Book Company, New York, New York.

Bishop, G. C., W. T. Ellison and L. E. Mellberg. 1987. A simulation model for high-frequency under-ice reverberation. Journal of the Acoustical Society of America 82(1)**:** 275-285.

DoN (Department of the Navy). 2001. Final Overseas Environmental Impact Statement and Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar. Washington, DC: Chief of Naval Operations.

DoN (Department of the Navy). 2007. Final supplemental environmental impact statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar. Washington, D.C: Department of the Navy, Chief of Naval Operations.

JASA (Journal of the Acoustical Society of America). 2005. Special issue on the North Pacific Acoustic Laboratory. Vol. 117, Issue 3, Part 2, pp 1499-1673.

Kerr, George A. and George P. Cloy. 1994. Northern Hemisphere Shallow-Water Acoustic Ducts. Naval Research Laboratory Technical Report NRL/MR/7182—94-7540. Naval Research Laboratory, Stennis Space Center, MS 39529-5004, June 3, 1994.

NAVOCEANO (Naval Oceanographic Office). 1982. Typical Expendable Bathythermograph (TXBT) Data Base, Pacific Ocean, Naval Oceanographic Office Reference Publication, RP-42B. Commanding Officer Naval Oceanographic Office, NSTL Station, Bay St. Louis, MS 39522.

Oceanographic and Atmospheric Master Library (OAML). 2002. Oceanographic and Atmospheric Master Library. Commander, Navy Meteorology and Atmospheric Command, Stennis Space Center, Mississippi.

OAML. 2000. Database description for the General Digital Environmental Model - Variable Resolution (GDEM-V) Version 2.5. Ocean and Atmospheric Master Library, June 2000.

Podezwa, Eugene M. 1976. Sound Speed Profiles of the North Pacific Ocean, NUSC Technical Document 5271, Naval Underwater Systems Center, New London, CT.

Porter, M. B. 1992. The KRAKEN Normal Mode Program. Naval Research Laboratory, May 22, 1992.

Sonntag, R. M., W. T. Ellison, C. W. Clark, D. R. Corbit and B. D. Krogman. 1986. A description of a tracking algorithm and its application to bowhead whale acoustic location data collected during the spring migration near Point Barrow, Alaska 1984-85. Report of the International Whaling Commission 36**:** 299-310.

U.S. Department of Commerce. 2001. 2-minute Gridded Global Relief Data (ETOPO2) National Oceanic and Atmospheric Administration, National Geophysical Data Center.

Weinberg, H., D.L. Deavenport, E.H. McCarthy, and C.M. Anderson. (2001). "Comprehensive Acoustic System Simulation (CASS) Reference Guide." NUWC-NPT, TM 01-016, Naval Undersea Warfare Center, Division, Newport, RI , March 2001.

Zingareli, R., D. King, L. Gainey and E. Holmes. 1999. Software Test Description for the Parabolic Equation/Finite Element Parabolic Equation Model Version 5.0.

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