



JUN 30 2010

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act (NEPA), an environmental review has been performed on the following action.

TITLE: Environmental Assessment on the Effects of Scientific Research Activities Associated with Behavioral Response Studies of Pacific Marine Mammals Using Controlled Sound Exposure

LOCATION: Coastal waters of California, especially within the U.S. Navy's Southern California Range Complex, and primarily near San Clemente Island

SUMMARY: The action is issuance of a permit under the Marine Mammal Protection Act and Endangered Species Act to the NOAA Office of Science and Technology, Silver Spring, MD, for research to determine how human sounds, including active sonar signals, affect marine mammals. The research involves vessel-based activities including attachment of scientific instruments, behavioral observations, and exposure to controlled levels of natural and anthropogenic underwater sounds. These activities will result in short-term adverse impacts on specified numbers of target and non-target animals over the five year duration of the permit. No other component of the environment is expected to be affected by the permitted research.

RESPONSIBLE OFFICIAL:

James H. Lecky
Director, Office of Protected Resources
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
1315 East-West Highway, Room 13821
Silver Spring, MD 20910
(301) 713-2332

The environmental review process led us to conclude that this action will not have a significant effect on the human environment. Therefore, an environmental impact statement will not be prepared. A copy of the finding of no significant impact (FONSI) including the supporting environmental assessment (EA) is enclosed for your information.

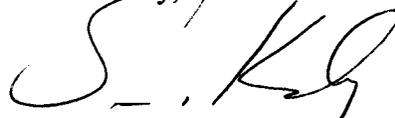


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Although NOAA is not soliciting comments on this completed EA/FONSI we will consider any comments submitted that would assist us in preparing future NEPA documents. Please submit written comments to the responsible official named above.

Sincerely,

A handwritten signature in black ink, appearing to read "P. N. Doremus".

Paul N. Doremus, Ph.D.
NOAA NEPA Coordinator

for

Enclosure

ENVIRONMENTAL ASSESSMENT
ON THE EFFECTS OF SCIENTIFIC RESEARCH ACTIVITIES
ASSOCIATED WITH BEHAVIORAL RESPONSE STUDIES OF PACIFIC MARINE
MAMMALS USING CONTROLLED SOUND EXPOSURE

June 2010

Lead Agency: USDC National Oceanic and Atmospheric Administration
National Marine Fisheries Service, Office of Protected
Resources

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Abstract: The National Marine Fisheries Service (NMFS), Office of Protected Resources (OPR), proposes to issue a scientific research permit for takes of marine mammals in the wild, pursuant to the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq.). The primary objective of the proposed research is to support conservation management by providing empirical measurements of behavior in marine mammals and behavioral changes as a function of sound exposure. The permit applicant would observe behavioral responses in several marine mammal species exposed to controlled underwater sound exposures and quantify exposure conditions associated with various effects. This information would be used to determine the acoustic exposures of mid-frequency (MF) sonar sounds that elicit an identifiable behavioral indicator response in targeted marine mammals, so that sound producers and regulatory agencies can better understand, minimize, and manage noise impacts on protected species. Additionally, the applicant proposes to conduct photo-identification of marine mammals and collect skin samples for genetic analysis. The action area for the proposed study includes the U.S. Navy's existing Southern California (SOCAL) Range Complex, other US locations including offshore waters, and international waters throughout the Pacific basin. Scientific research permits are generally categorically excluded from the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 et seq.) requirements to prepare an environmental assessment (EA) or environmental impact statement (EIS) (NAO 216-6). However, NMFS chose to prepare an EA as a more detailed analysis of potential environmental impacts.

ACRONYMS AND ABBREVIATIONS

AAM	Active Acoustic Monitoring
ABR	Auditory Brainstem Response
ADC	Analog-Digital Converter
ATOC	Acoustic Thermometry of Ocean Climate
AUTEC	U.S. Atlantic Undersea Test and Evaluation Center
BEQ	Bachelor Enlisted Quarters
BRS	Behavioral Response Study
CA	Close Approach
CDFG	California Department of Fish and Game
CEE	Controlled Exposure Experiment
CETAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulations
CI	Confidence of Intervals; Co-Investigator
CINMS	Channel Islands National Marine Sanctuary
CITES	Convention on International Trade in Endangered Species
cm	centimeter(s)
CV	Coefficient of Variation
dB	decibel(s)
DDT	Dichloro-diphenyl-trichloroethane
DOC	Department of Commerce
DON	Department of the Navy
EA	Environmental Assessment
EFH	Essential Fish Habitat(s)
EIS	Environmental Impact Statement
EKG	Electrocardiogram
ESA	Endangered Species Act
Et seq	Et sequential
FAO	Fisheries and Agriculture Organization
FEIS	Final Environmental Impact Statement
FF	Focal Follow
FM	Frequency Modulated
FMP	Fishery Management Plan(s)
FOEIS	Final Overseas Environmental Impact Statement
FONSI	Finding of No Significant Impact
FR	Federal Register
ft	feet
FWS	Fish and Wildlife Service
Gb	Gigabyte(s)
GOMEX	Gulf of Mexico
HMS	Highly migratory species
hr	hour
Hz	Hertz
IACMST	Inter-Agency Committee on Marine Science and Technology (United Kingdom)
ICW	Intra-Coastal Waterway
IUCN	International Union for Conservation of Nature and Natural Resources
JASA	Journal of the Acoustical Society of America
kHz	kiloHertz
km	kilometer(s)
km/hr	kilometer(s) per hour
kt	knot(s): nautical mile(s) per hr
LF	Low Frequency

m	meter(s)
Mb	Megabyte(s)
MBTA	Migratory Bird Treaty Act
MF	Mid-Frequency
mi	mile(s) (statute)
MICA	Mesure de l'Impact des Catures Accessoires
min	minute(s)
MMA	Marine Managed Area(s)
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MPA	Marine Protected Areas
MSL	Mean Sea Level
NATO	National Oceanic and Atmospheric Administration
NEO	NOAA Executive Order
NEPA	National Environmental Policy Act of 1969
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NURC	NATO Undersea Research Centre (formerly SACLANTCEN)
NUWC	Naval Underwater Warfare Center
OEIS	Overseas Environmental Impact Statement
OPAREA	Operational Area
OPR	Office of Protected Resources
OV	Observation and tracking Vessel
Pa	Pascal
PAM	Passive Acoustic Monitoring
PB	Playback
PBV	Play Back Vessel
PCB	Poly-Chlorinated Biphenyls
Pers. Comm.	Personal Communication
ppt	parts per thousand
psu	Parts per thousand salinity units
PTS	Permanent Threshold Shift
RDT&E	Research, Development, Test and Evaluation
RL	Received Level
rms	root mean squared
SACLANTCEN	Supreme Allied Commander, Atlantic: Undersea Research Centre
SAG	Surface Action Group
SARA	Canada's Species at Risk Act
SCANS	Small Cetaceans in the North Sea
SCB	Southern California Bight
SCI	San Clemente Island
SCIUR	San Clemente Island Underwater Range
SCORE	Southern California Offshore Range
sec	Second(s)
SEL	Sound Exposure Level
SL	Source Level
SOAR	Southern California Anti-Submarine Warfare Range
SOCAL	Southern California
SONAR	SOund Navigation And Ranging
SPE	Society of Petroleum Engineers
SPL	Sound Pressure Level
Spp	Species
SRP	Scientific Research Permit

TAG	Tag Attachment Vessel
TL	Transmission Loss
TOTO	Tongue of the Ocean
TTS	Temporary Threshold Shift
U.S. or US	United States
U.S.C.	United States Code
UN	United Nations
USFWS	United States Fish and Wildlife Service
WHOI	Woods Hole Oceanographic Institution
WTV	Whale Observation/Tag tracking Vessel

Symbols	
=	Equal to
/	Divided by
+	Plus
≥	Greater than or equal to
>	Greater than
<	Less than
~	Approximately
±	Plus or minus
μ	Micro (10 ⁻⁶)
Log	Logarithm

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CHAPTER 1. PURPOSE AND NEED FOR ACTION

1.1 Description of Action

In response to receipt of an application from the National Marine Fisheries Service (NMFS) Office of Science and Technology, (File No. 14534), NMFS Office of Protected Resources proposes to issue a scientific research permit for “takes”¹ by “level B harassment”² of marine mammals in the wild pursuant to the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq.), the regulations governing the taking and importing of marine mammals (50 CFR part 216), the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.), and the regulations governing the taking, importing, and exporting of endangered and threatened species (50 CFR 222-226).

The scientific research activity proposed by the permit applicant is to collect and provide empirical measurements of behavior in marine mammals both in the absence of and as a function of sound exposure. This research program would provide both basic and applied scientific data useful to sound-producing entities (such as the U.S. Navy) and to regulatory agencies (including NMFS) in support of conservation management of important human activities in the ocean. The permit applicant would observe behavioral responses in several marine mammal species in unaltered conditions and those exposed to controlled underwater sound exposures and quantify exposure conditions associated with various effects. This information would be used to determine the characteristics and contexts of acoustic exposures by anthropogenic sounds, including simulated military, mid-frequency (MF) sonar signals, that elicit identifiable behavioral responses in targeted marine mammal species, so that sound producers and regulatory agencies can better understand, minimize, and manage noise impacts on protected species. The collected data would also be used to assess species differences in vocal behavior that might be used to identify presence and possibly abundance of these species.

These overall objectives would be accomplished by performing a multi-stimulus behavioral response study (BRS) to assess responses of a variety of marine mammals intentionally exposed to underwater natural sounds, novel synthetic sounds, and simulated MF sonar sounds. This effort would build on the safe and successful BRS experiments conducted in the Bahamas in 2007 and 2008 (under NMFS Permit No. 1121-1900), using similar methodologies and

¹ Under the MMPA, “take” is defined as “harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect.” [16 U.S.C. 1362(18)(A)] The ESA defines “take” as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” The term “harm” is further defined by regulations (50 CFR §222.102) as “an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering.”

² “Harass” is defined by regulation (50 CFR §216.3) as “Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but does not have the potential to injure a marine mammal or marine mammal stock in the wild (Level B harassment).”

protective protocols to minimize risk, as well as similar studies conducted in summer 2009 in the Mediterranean Sea (under NMFS Permit No. 14241). The target species include beaked whales and other odontocetes, key baleen whales, and pinniped species for whom such data have not been previously obtained. In addition to targeted species, other marine animals may also be unintentionally exposed to experimental sounds, including endangered blue, fin, sperm, humpback, and sei whales, as well as threatened Guadalupe fur seals. Table 1-1 provides a list of target species proposed for intentional exposure, as well as other species that may be unintentionally exposed.

Table 1-1: Marine Mammal Species in Vicinity of Proposed Action

Common Name	Scientific Name	Stock(s) (Info Source <i>Caretta et al</i> 2008)	Abundance (CV)	MMPA (depleted, strategic), ESA (threatened or endangered), CITES Status (Apx I, II, or III)	Target or Non-target species
MYSTICETES					
Blue whale	<i>Balaenoptera musculus</i>	Eastern North Pacific	1368 (0.22)	Depleted / Strategic / Endangered / Cites App I	Target
Fin whale	<i>B. physalus</i>	California/ Oregon/ Washington	2636 (0.15)	Depleted / Strategic / Endangered / Cites App I	Target
Sei whale	<i>B. borealis</i>	Eastern North Pacific	46 (0.61)	Depleted / Strategic / Endangered / Cites App I	Non-target
Bryde's whale	<i>B. edeni</i>	Eastern Tropical Pacific	No current estimate of minimum abundance is available.	Cites App I	Non-target
Minke whale	<i>B. acutorostrata</i>	California/ Oregon/ Washington	806 (0.63)	Cites App I	Non-target
Humpback whale	<i>Megaptera novaeangliae</i>	California/ Oregon/ Washington	1391 (0.13)	Depleted / Strategic / Endangered / Cites App I	Non-target
Gray whale	<i>Eschrichtius robustus</i>	Eastern North Pacific	18,813 (0.07)	Delisted in Eastern North Pacific / Cites App I	Target
ODONTOCETES					
Sperm whale	<i>Physeter macrocephalus</i>	California/ Oregon/ Washington	2853 (0.25)	Depleted / Endangered / Cites App I	Target
Pygmy sperm whale	<i>Kogia breviceps</i>	California/ Oregon/ Washington	unk (unk)		Non-target
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	California/ Oregon/ Washington	2830 (0.73)		Target
Baird's beaked whale	<i>Berardius bairdii</i>	California/ Oregon/ Washington	540 (0.54)		Target

Common Name	Scientific Name	Stock(s) (Info Source Caretta et al 2008)	Abundance (CV)	MMPA (depleted, strategic), ESA (threatened or endangered), CITES Status (Apdx I, II, or III)	Target or Non-target species
Mesoplodonts [includes Blainville's beaked whale (M. densirostris), Hubb's beaked whale (M. carlhubbsi), Perrin's beaked whale (M. perrini), pygmy beaked whale (M. peruvianus), and ginkgo-toothed beaked whale (M. ginkgodens)]	<i>Mesoplodon sp.</i>	California/ Oregon/ Washington	1024 (0.77)		Blainville's beaked whale is Target
Killer whale	<i>Orcinus orca</i>	Eastern North Pacific Offshore	353 (0.29)	Depleted / Endangered for Southern Resident	Non-target
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	California/ Oregon/ Washington	245 (0.97)		Target
Risso's dolphin	<i>Grampus griseus</i>	California/ Oregon/ Washington	11,621 (0.17)		Non-target
Bottlenose dolphin	<i>Tursiops truncatus</i>	California/ Oregon/ Washington offshore	3495 (0.31)		Non-target
Striped dolphin	<i>Stenella coeruleoalba</i>	California/ Oregon/ Washington	17,925 (0.37)		Non-target
Pacific white- sided dolphin	<i>Lagenorhynchus obliquidens</i>	California/ Oregon/ Washington	20,719 (0.22)		Non-target
Short-beaked common dolphin	<i>Delphinus delphis</i>	California/ Oregon/ Washington	392,733 (0.18)		Target
Long-beaked common dolphin	<i>Delphinus capensis</i>	California/ Oregon/ Washington	15,335 (0.56)		Non-target

Common Name	Scientific Name	Stock(s) (Info Source Caretta et al 2008)	Abundance (CV)	MMPA (depleted, strategic), ESA (threatened or endangered), CITES Status (Apdx I, II, or III)	Target or Non-target species
Northern right whale dolphin	<i>Lissodelphis borealis</i>	California/ Oregon/ Washington	12,876 (0.30)		Target
Dall's porpoise	<i>Phocoenoides dalli</i>	California/ Oregon/ Washington	48,376 (0.24)		Non-target
CARNIVORES - Pinnipeds					
Northern fur seal	<i>Callorhinus ursinus</i>	San Miguel Island	9,424 (n/a)	Depleted Pribilof Island and Eastern Pacific	Non-target
Guadalupe fur seal	<i>Arctocephalus townsendi</i>	Mexico to California	7,408 (n/a)	Depleted / Strategic / Threatened / Cites App I	Non-target
California sea lion	<i>Zalophus californianus</i>	U.S.	238,000 (n/a)		Target
Northern elephant seal	<i>Mirounga angustirostris</i>	California breeding	124,000 (n/a)		Non-target
Harbor seal	<i>Phoca vitulina</i>	California	34,233 (n/a)		Target
Stellar sea lion	<i>Eumetopias jubatus</i>	California/ Oregon/ Washington	3,681 (n/a)	Depleted / Threatened	Non-target
CARNIVORES - Mustelid					
Southern Sea Otter	<i>Enhydra lutris nereis</i>	California	2,359 (n/a)	Depleted / Threatened [main distribution at San Nicolas Island north of the SOCAL Range Complex is translocated population of approximately 29 animals is experimental population not considered threatened.]	Non-target

1.1.1 Background

As the issue of noise impacts on marine mammals, and particularly the effects of sonar on species including beaked whales, has received increased attention in the past decade in scientific, regulatory, legal, and general public arenas, many meetings and workshops have been convened. Participating parties from a wide range of perspectives have generally concluded that the data are insufficient to develop anything other than highly precautionary, and in some cases arbitrary, approaches to the management of marine mammals in the face of apparent threats. Many of the resultant reports on marine mammals and underwater sound (National Research Council 1994, 2000, 2003, 2005; the International Council for Exploration of the Seas 2005a; and the UK Inter-

Agency Committee on Marine Science and Technology 2006), the report of a technical workshop on beaked whales (Cox *et al.* 2006), and a U.S. federal task force devoted to developing a ten-year integrated research strategy for the U.S. government (Southall *et al.*, 2009) recommend an experimentally-based approach to addressing the need for new and reliable data on how beaked whales and other marine mammals respond to sonar and other underwater anthropogenic sounds. Specifically, the report of the UK Inter-Agency Committee on Marine Science and Technology (IACMST) Working Group on Underwater Sound and Marine Life (IACMST, 2006) recommended BRS-type experiments “to yield much needed quantifiable information on the effects of different sound sources on marine animals.” The BRS research proposed by the applicant was designed following an experimental-based team approach, along with appropriate precautions to control associated risks to the marine mammals, while still yielding useful information.

The permit applicant proposes a multi-phase field BRS research effort (2010-2015) to conduct a combination of observational studies involving acoustic exposures to a number of marine mammal species (the primary target species being beaked whale species) using various underwater sounds. The exposures would be carefully controlled to yield useful scientific data on behavioral responses, while avoiding harm to experimental subjects, in order to predict the probability of responses such as avoidance behavior given certain acoustic stimuli and exposure conditions. Additionally, the permit applicant proposes to collect skin samples and conduct photo-identification of marine mammals in order to support genetic assessments of species, sub-species, and local populations.

Both basic and applied research questions would be addressed, all of which have direct implications for increasing understanding and effective conservation management of marine mammals. Some of the research objectives would provide measurements for target species for which robust data is lacking; others build on previous research (much of it conducted by the principal and co-investigators) or tests similar procedures in new areas and contexts. Several specific hypotheses would be tested in obtaining these measurements, including that species differences in vocal behavior can increasingly be used to identify presence and possibly abundance of these species and that marine mammal behavior would change in a variety of ways based on characteristics and contexts of sound exposure. There are a number of scientific means for addressing such issues, including opportunistic observations around on-going exercises involving sound sources of interest. While these measurements are important (and ongoing in several places, including the study area proposed for the work in this permit), they will remain limited in terms of providing specific information on individual responses. This is the kind of information required for most means of estimating the potential for harm from sound exposure under current regulatory regimes. Clearly, the opportunistic data are useful and needed, but arguably they will be most useful in conjunction with controlled exposure experiments (CEE) to provide the fine granularity of detail on individual responses (Tyack, 2004; Southall *et al.*, 2007). CEEs are the proposed experimental approach for this study, involving the tagging of individual animals with measurements of behavioral response and other data before, during, and following directed sound exposures of different types. These experiments would build on previous successful experimental efforts in the Bahamas (called “Behavioral Response Study” or (BRS)) and planned research in summer 2009 in the Mediterranean Sea (MED-09). Such experiments have and will be conducted with specific protective protocols for ensuring the research is

conducted safely and humanely, many of which are also integrated into the experimental approach proposed here.

1.1.2 Research Questions to be Investigated

- 1) What are the types and characteristics of vocal signals produced by different marine mammal species, and what are their communicative and echolocation functions?
- 2) How do marine mammals respond to ecologically relevant sounds from a common predator, the killer whale (*Orcinus orca*)?
- 3) How do marine mammals respond to sonar and other sounds? What are the types and contexts of exposure resulting in different kinds of behavioral responses in different species? Can these responses be related to risk factors for more severe behavioral responses and/or injury? Are there particularly sensitive and generally tolerant marine mammal species with regard to acoustic exposure?

This research seeks to define how marine mammals (including possibly quite sensitive species such as beaked whales, see Southall *et al.*, 2007) respond to specific exposure levels of sonar and other sounds. It is built around three specific questions related to identification of risk factors for stranding in beaked whales (and possibly other marine mammals) exposed to various sounds. The first question concerns whether responses to band-limited sounds can be related to sensitivity of hearing in those frequency bands (i.e., the sensation level of exposure), the second, whether variation in anti-predator responses relate to risk factors for stranding, and the third, whether different species have different behavioral responses (and thus potentially different risk factors) from exposure to anthropogenic sounds, including simulated military sonar.

The researchers would begin to investigate these questions by examining behavioral responses to underwater MF sounds (initiated with the animal at depth), including dive depth and duration, surfacing frequency and duration, respiration and heart rate (at the surface), vocal reactions (e.g., cessation of clicking) and changes in social cohesion. This would be accomplished with visual and passive acoustic monitoring (PAM) from the research vessels, PAM and localization data from the underwater range hydrophones, and data from digital acoustic tags on the target animal(s). Every effort would be made to ensure that these exposures do not pose a risk of injury to the subjects, including specific shutdown criteria for terminating exposures based on vocal behavior in the target animals and proximity to target or incidental animals. Analyses of results would include assessment of any relationship between sound exposure conditions (including received level (RL), exposure duration, type of signal, and other contextual variables such as relative movement between source and receiver) and the magnitude of behavioral response.

1.1.3 Manner in Which the Activity Involves the Taking of Marine Mammals

Although the primary species of concern are beaked whales, the responses of other marine mammal species would be monitored. Plans are for beaked whales to be the primary target species for tagging and playback experiments during Phase I (2010), to be conducted in Southern California offshore waters and primarily on U.S. Navy underwater ranges in the vicinity of San Clemente Island. These underwater ranges are components of the Navy's Southern California

(SOCAL) Range Complex. See Figure 1-1. They are controlled by the Southern California Offshore Range (SCORE) integrated training facility, which has its Range Operations Center at the Naval Air Station (NAS) North Island, San Diego CA. When beaked whales are not available, other marine mammals would be used as target species, see Table 1-1. The target species would be purposely exposed to anthropogenic underwater MF sounds, photo-identified, tagged and, due to the nature of tagging, skin samples would be collected for analysis. Hence, the permit applicant requests the collection of skin samples, close approach for photo-identification, as well as intentional MMPA Level B³ harassment takes of target and unintentional Level B harassment takes of non-target marine mammals that could possibly be in the vicinity of the BRS research area. Visual and passive acoustic monitoring, and other safeguards would be implemented to minimize to the greatest degree possible the potential for Level A⁴ harassment takes of marine mammals; and there would be clear source shutdown criteria to limit exposure to Level B harassment before any injurious behavioral responses occur.

The minimum exposure level for Phase I would be selected using response data from exposures of beaked whales to underwater MF sound in previous BRS research conducted on the instrumented AUTEK range in 2007 and 2008. A benefit associated with conducting tests on an undersea range where beaked whales can be acoustically monitored with existing permanent seafloor hydrophones is that it is possible to assess exposures where there is no noticeable change in location and timing of foraging dives vs. exposures associated with changes in behavior, such as cessation of vocalization. Data collected during range exercises involving underwater MF sound and during control periods (no underwater anthropogenic sound) help to define exposures at the onset of beaked whale click cessation, which would be factored into the minimum animal RL for Phase I playbacks.

The proposed Phase I field research activity is being planned for conduct during the late summer to fall 2010 timeframe. The target location for the initial fieldwork is the U.S. Navy SOCAL Range Complex and its associated underwater acoustic ranges. Later phases of this research, which are in early formative planning, are also being planned for the SOCAL Range Complex, as well as for potential activities at the U.S. Navy Hawaii Range Complex and other Pacific Ocean locations.

³ The MMPA defines level B harassment as “any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild.”

⁴ The MMPA defines level A harassment as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild.”

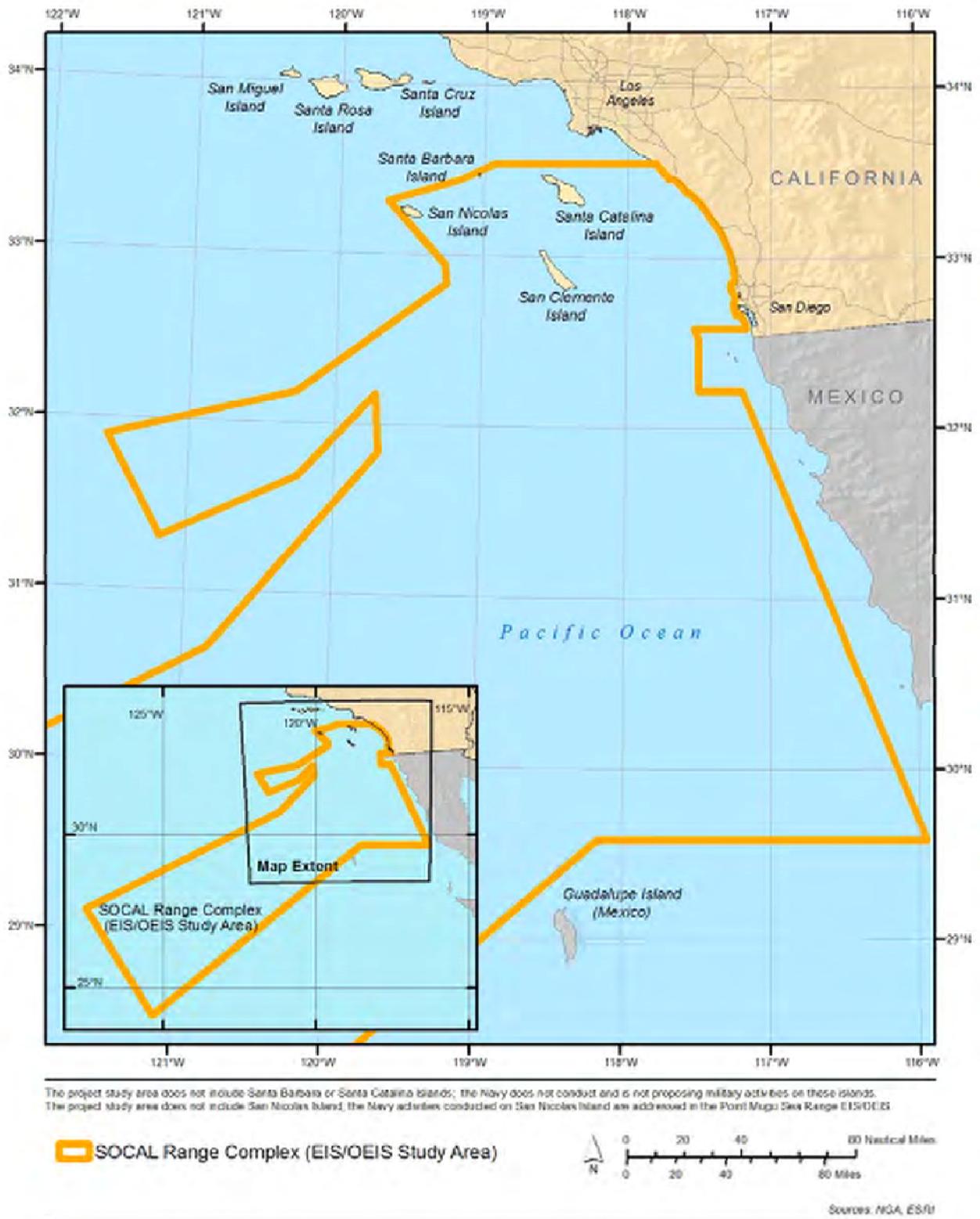


Figure 1-1: SOCAL Range Complex (DON, 2008)

1.1.4 Purpose and Need

Need for the Research: There is a distinct and validated need for field research to understand behavioral and physiological responses of beaked whales, as well as other marine mammals, to underwater anthropogenic sounds, including MF sonar sounds, and how these responses may pose a risk of stranding and/or injury. NOAA, Navy, and the marine biological research community in general, have not been able to gain a firm grasp on the acoustic mechanism of the observed effects on beaked whales from MF sonar sounds. This has hampered various efforts of the U.S. government to meet its mandated requirements for marine conservation while enabling military training activities that are critical to national security. The behavioral response studies to be undertaken under the proposed permit would benefit future efforts at minimizing underwater sound impacts to beaked whales and other marine mammals through better understanding of their responses to MF sonar sound signals. Comparison of responses of beaked whales to other odontocetes in turn could provide benefit to all deep-diving odontocete species, and would also contribute to general understanding of the reactions of marine mammals to underwater sound exposure.

The proposed multi-phase BRS research activity is a five-year study that would examine the responses of various marine mammals (including beaked whales, other deep-diving odontocetes, mysticetes, and pinnipeds) to various underwater coherent/incoherent sounds. The purpose of the field research is to quantify the behavioral responses of marine mammals to known acoustic exposure events. This type of field research has been repeatedly identified by various reports by the National Research Council (1994; 2000; 2003; 2005) as a critical data need and was unanimously identified as the foremost data need regarding beaked whales and sonars at the Marine Mammal Commission (MMC) symposium on beaked whales in 2006 (see Cox *et al.*, 2006). Also, the paucity of direct behavioral information on the potential effects of active military sonar and offshore oil/gas exploration on marine mammals is clearly one of the most challenging issues facing NMFS in managing oceanic noise issues.

Purpose of and Need for the Proposed Action: The purpose of issuing research permits is to facilitate *bona fide* research on marine mammals, the results of which is likely to contribute to the basic knowledge of marine mammal biology or ecology or is likely to identify, evaluate, or resolve conservation problems⁵. Research is needed because “there is inadequate knowledge of the ecology and population dynamics of such marine mammals and of the factors which bear upon their ability to reproduce themselves successfully.” [16 U.S.C. 1361; Section 2: Findings and Declaration of Policy] It is the policy of the MMPA that marine mammals “should be protected and encouraged to develop to the greatest extent feasible commensurate with sound policies of resource management.” As the federal agency with jurisdiction over all cetacean and

⁵ The MMPA’s definition of *bona fide* research also includes “results of which likely would be accepted for publication in a [refereed] scientific journal.” NMFS assumes that research which contributes to the basic knowledge of marine mammal biology or ecology or identifies, evaluates, or resolves conservation problems would be acceptable for such publication, but research that does not accomplish these things would not likely be considered for publication.

pinniped (except walrus) species, NMFS has a responsibility to implement the MMPA to protect and conserve marine mammals under its jurisdiction using “sound policies of resource management.” Sound policies are those that are reasoned, or logically valid, or otherwise rely on good judgment. Such reasoned or logical principles for management of marine mammals necessarily rely on adequate and appropriate information about the marine mammals and the environmental factors that influence their populations.

For marine mammals listed as threatened or endangered under the ESA, permits issued for scientific purposes allow an exception to the prohibitions of section 9 of the ESA provided such exception is consistent with the purpose and policy of the ESA. The purpose of the ESA is to provide a means and a program for the conservation of listed species. It is the policy of the ESA that federal agencies should seek to conserve listed species and use their authorities to promote the conservation purpose of the statute. The ESA defines conserve and conservation as using all methods and procedures necessary to bring listed species to the point at which the measures provided under the ESA are no longer necessary. When the protective measures of the ESA are no longer considered necessary for the conservation of the species, the species is considered recovered. By definition, those methods may include activities associated with “scientific resources management” such as research and census. Thus, the purpose of issuing permits for research on threatened and endangered species of marine mammals is to promote recovery of those species.

1.1.5 Objectives

The objective of the proposed research is to observe behavioral responses in several marine mammal species (especially beaked whales) exposed to natural and artificial underwater sounds, quantify exposure conditions associated with various effects, collect skin samples (as a result of tagging of animal subjects), and conduct photo-identification of animal subjects targeted for close approaches, focal follows and tagging.

1.2 Other EA/EIS that Influence Scope of this EA

There are four EAs and one FEIS that influence the scope of this EA. Three of the separate EAs, prepared by NMFS in 2000, 2003, and 2007 (NMFS 2000, 2003a, 2007), evaluated the environmental impacts of issuing scientific research permits to study the effects of controlled exposure of sound on the behavior of various species of marine mammals. These activities are similar in nature to the activities proposed within this EA. The fourth EA and the referenced FEIS address activities different from those proposed here, but are for similar geographic regions as proposed for the research discussed herein. The fourth EA, prepared by NMFS in 2003 (NMFS 2003b), evaluated the environmental impacts of issuing a scientific research permit to study the effects of activities associated with the development of a low-power high-frequency sonar system to detect marine mammals off the coast of California. The FEIS prepared by U.S. Navy provided important information on range complex infrastructure that would be leveraged during the proposed research, as well as information on the local environment and species likely to be encountered during the initial phase of the proposed research. Each of the documents is summarized below.

In response to an application (Permit No. 981-1578) from Dr. Peter Tyack, Woods Hole Oceanographic Institution (WHOI), for a permit to conduct research involving exposure of marine mammals to mid- and high-frequency sound in the North Atlantic and Mediterranean Sea, NMFS prepared an EA on the effects of controlled exposure of sound on the behavior of various species of marine mammals (NMFS 2000). The primary research objective was to determine what characteristics of exposure to specific sounds evoke minor behavioral responses in marine mammals. The EA examined the environmental consequences of two alternatives: No Action (denial of the permit) and the Proposed Action (permit issuance), which included mitigation measures that would be implemented as part of the permit. The specific playback protocols examined involved exposure of animals to playbacks of low-power, mid- to high-frequency active sonar designed to detect marine mammals. The proposed RLs for the playbacks were not to exceed 160 dB. Other characteristics of the signals included bandwidths of 100, 200, and 400 Hz; pulse durations of 50, 100, 200, and 400 milliseconds; chirp upsweeps centered at 1, 2.5, 4, 8, and 12 kHz; and a pulse repetition rate of not more than one ping per minute. A Finding of No Significant Impact (FONSI) was signed on August 31, 2000, based on information indicating that the short-term impacts of conducting acoustic playback experiments on cetaceans would not result in more than a temporary shift in the hearing thresholds of some individual cetaceans, and that changes in the behavior (to avoid the sounds) of individual animals were expected to have negligible impacts on the animals, and the species.

In response to a follow-on application submitted by Dr. Tyack (Permit 981-1707), a second EA was prepared on the effects of controlled exposure of sound on the behavior of various species of marine mammals (NMFS 2003a) in the North Atlantic, including the Gulf of Mexico, and Mediterranean Sea. The principal differences in the proposed action for the second EA compared to the first were an expanded geographic scope and an increase in the sound levels produced. The second application and EA were prepared following litigation involving Dr. Tyack's original permit (No. 981-1578), in which the court invalidated amendments to the permit that were not specifically analyzed in the first EA (*Hawaii County Green Party vs. Evans*, C-03-0078-SC, U.S. District Court, Northern District of California). A FONSI for the second EA was signed in June 2003, based on information indicating that the short-term impacts of conducting acoustic playback experiments on cetaceans would not result in more than a temporary shift in the hearing thresholds of some individual cetaceans, and that changes in the behavior (to avoid the sounds) of individual animals were expected to have negligible impacts on the animals, and the species.

The third EA was prepared by NMFS (NMFS 2007) in response to a permit application from the National Marine Fisheries Service (NMFS) Office of Science and Technology, (File No. 1121-1900) for research to be conducted in the Tongue of the Ocean (east of Andros Island, Bahamas). The primary research objective was to observe behavioral response in several deep-diving cetacean species intentionally exposed to natural and artificial underwater sounds and quantify exposure conditions associated with various effects. The specific playback protocols examined involved exposure of animals to playbacks of low-power, mid- to high-frequency coherent and incoherent sound source transmissions. The proposed RLs for the playbacks were not to exceed 170 dB. Passive acoustic monitoring was planned to follow the movement and vocal behavior of beaked whales exposed to these playbacks and compared to silent control conditions. Tagging was also to be employed to detect animal reaction. Mitigation measures were to be employed. A

FONSI was signed on August 14, 2007, based on information indicating that the permitted research would be of limited duration and small geographic scope, and was not expected to result in more than short-term disturbance of small numbers of marine mammals.

A fourth EA, prepared by NMFS in 2003 (NMFS 2003b), was in response to an application from Dr. Peter J. Stein, Scientific Solutions, Inc., Nashua, New Hampshire (Permit No. 1048-1717). It evaluated the environmental impacts of issuing a scientific research permit to study the effects of exposing gray whales (*Eschrichtius robustus*) migrating offshore of central California to low-powered high-frequency active sonar, while simultaneously recording any reactions of the animals to the sound. The objective of the proposed research included gathering data on the sonar reflectivity of whales, the probability of their detection out to one mile, and the reaction of the animals to high frequency active sonars designed to detect marine mammals. In addition to the target species, which was not listed under the ESA, the applicant also requested authorization for unintentional "takes" of other non-target marine mammal species that may be within the range of the whale-finder sonar systems, including endangered blue, fin, sei, sperm, and humpback whales, and threatened Steller sea lions and Guadalupe fur seals. During review of the application and preparation of an EA, it was determined that the probability of blue, fin, sei, humpback or sperm whales being present in the study area at the time of the proposed research was too low to predict. It was also determined that, with the exception of sperm whales, these endangered whale species would not likely be able to hear the high frequency whale-finder sonars or otherwise be affected. Thus, NMFS chose not to issue a permit for takes of these species since none were likely. Similarly, the probability of a Guadalupe fur seal or Steller sea lion being present in the study area at the time of the proposed study was determined to be too low to predict so no takes were authorized for these threatened species. A Finding of No Significant Impact (FONSI) was signed on December 23, 2003 based on analysis that resulted in no anticipation of any adverse impacts to the populations or to the ecosystem as a result of the authorized activities, and upon receipt of concurrence from the Endangered Species Division.

In December 2008, the United States Navy published its Final Environmental Impact Statement (FEIS) for its Southern California Range Complex (DON 2008). While the scope of the planned research presented here differs significantly from the activities presented by the Navy, the initial phase of this research would take place in the same geographic region and would take advantage of the Navy's underwater tracking ranges in the vicinity of San Clemente Island. This recent FEIS provides a detailed description of the range facilities, as well as an important cross-reference for descriptions of the local environment and species likely to be encountered during the proposed research.

Although three of the referenced EAs were not for the same geographic area as the proposed action, analysis of the information in these documents suggests that the potential impacts of the proposed action would be limited to the biological environment and, more specifically, to marine organisms within range of the sounds from the anthropogenic sound-producing systems proposed in this EA. The previous EAs also suggest that there are not likely to be any measurable impacts from the proposed action on social or economic aspects, nor on the physical environment. Similarly, invertebrates, fish, sea turtles, and sea birds that may be within the range of the sounds from the anthropogenic sound-producing systems proposed in this EA are not likely to be affected, for reasons discussed in these previous EAs, and summarized in Chapters 3 and 4 of this EA. The fourth EA and the referenced FEIS are for the same geographic area as the

proposed research. These documents provide extensive cross-references regarding the local environment and species likely to be encountered during the conduct of research activities. Overall, the issues within the scope of this EA are primarily related to the potential impacts of the proposed action on marine organisms, especially marine mammals targeted by the research.

1.3 Decision and other Agencies Involved in this Analysis

NMFS must decide whether issuing a scientific research permit for the proposed action would be consistent with the purposes and policies of the MMPA, ESA, and NMFS implementing regulations, including making certain the permitted activities would not operate to the disadvantage of any endangered or threatened species. Pursuant to 50 CFR § 216.33 (d)(2), NMFS consults with the Marine Mammal Commission (MMC) in reviewing an application for a scientific research permit under the MMPA.

1.4 Scoping Summary

The purpose of scoping is to identify the issues to be addressed and the significant issues related to the proposed action, as well as identify and eliminate from detailed study the issues that are not significant or that have been covered by prior environmental review. An additional purpose of the scoping process is to identify the concerns of the affected public and Federal agencies, states, and Indian tribes. CEQ regulations implementing NEPA do not require that a draft EA be made available for public comment as part of the scoping process.

The MMPA and its implementing regulations governing issuance of special exception permits for scientific research (50 C.F.R. §216.33) require that, upon receipt of a valid and complete application for a permit, and the preparation of any NEPA documentation that has been determined initially to be required, NMFS publish a notice of receipt in the *Federal Register*. The notice summarizes the purpose of the requested permit, includes a statement about whether an EA or EIS was prepared, and invites interested parties to submit written comments concerning the application. A draft EA was made available for public comment concurrent with the application for a permit. No one requested a copy of the draft EA and no comments were received on it.

NMFS received comments from the Marine Mammal Commission (MMC) on the application. The MMC recommended mitigation, monitoring, and research coordination conditions for inclusion in the permit. Some of the conditions recommended are standard permit conditions, that are included in all permits for research on marine mammals. Others were specific to the type of research proposed. Those specific conditions are already part of the applicant's protocol and would be incorporated in the permit by reference to the application. Thus, no changes to the proposed action were necessary as a result of MMC comments on the application.

Subsequent to the close of the comment period on the original application the applicant submitted an amended application with a request to (1) increase the number of Risso's dolphins (*Grampus griseus*), bottlenose dolphins (*Tursiops truncatus*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), and northern elephant seals (*Mirounga angustirostris*) that may be harassed by close approach, focal follow, tag attachment, and sound exposure, to include these species as focal animals in the overall objectives; (2) increase the number of requested

“tagless” playbacks for some cetacean species, such as blue whales (*Balaenoptera musculus*) and fin whales (*B. physalus*) and the social pelagic delphinids, but not for the more solitary and deep-diving beaked whale species, to increase data obtained on behavioral responses; (3) modify the proposed action area slightly northward to 35° 0' N; the longitude boundaries remain as before (from 116° 0' to 127° 0' W); and (4) clarify tagging and playback protocols and mitigation for when dependent calves are present.

The amended application was made available for public review and comment for 30 days and provided to the MMC. A revised draft EA was not made available during the comment period. The original draft sufficiently addressed the potential impacts of the action, including the proposed changes to protocols. The Marine Mammal Commission submitted a letter reiterating their comments on the original application and further recommending mitigation measures specific to the protocols for when dependent calves are present. The mitigation measures recommended by the MMC are part of the applicant's protocols, which would be incorporated in the permit by reference to the application. Comments received on the original and amended application will be considered in NMFS final decision on a permit.

This EA will not evaluate impacts of the proposed action on the social or economic environment. Analyses in previous EAs prepared for issuance of permits for research on pinnipeds, using similar research methods, demonstrated that issuance of research permits does not have a significant impact on the social or economic environment. Those previous analyses indicate that the effects of permit issuance are related to the conduct of the research they authorize, and that those effects are limited to components of the biological and physical environment. Specifically, there are effects of research on the animals that are the subject of the research, on non-target animals exposed to the presence or actions of the researchers, and, in some cases, on certain types of substrate (the physical environment) in the immediate vicinity of the research. Those previous analyses indicate that the effects on animals can be direct (caused by the action and occur at the same time and place as the action) and indirect (caused by the action, but are later in time or farther removed in distance), while effects on the physical environment are direct. Thus, issues within the scope of this EA include direct and indirect effects of the research activities on target and non-target animals, and direct effects on specific components of the physical environment.

1.5 Applicable Laws and Necessary Permits, Licenses, and Entitlements

This section summarizes federal, state, and local permits, licenses, approvals, and consultation requirements necessary to implement the proposed action, as well as who is responsible for obtaining them. This includes federal, state, or local permits and approvals that are the responsibility of the applicant to obtain.

1.5.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) was enacted in 1969 and is applicable to all “major” federal actions significantly affecting the quality of the human environment. A major federal action is an activity that is fully or partially funded, regulated, conducted, or approved by a federal agency. NMFS issuance of permits for research represents approval and regulation of activities. While NEPA does not dictate substantive requirements for permits, licenses, etc., it

requires consideration of environmental issues in federal agency planning and decision making. The procedural provisions outlining federal agency responsibilities under NEPA are provided in the Council on Environmental Quality's implementing regulations (40 CFR Parts 1500-1508).

NMFS procedures for complying with NEPA and the implementing regulations issued by the Council on Environmental Quality were established in NOAA Administrative Order (NAO) 216-6. This EA is prepared in accordance with NEPA, its implementing regulations, and NAO 216-6.

1.5.2 *Marine Mammal Protection Act*

The MMPA prohibits takes of all marine mammals in the U.S. (including territorial seas) with a few exceptions. Permits for *bona fide*⁶ scientific research on marine mammals, or to enhance the survival or recovery of a species or stock, issued pursuant to section 104 of the MMPA are one such exception. These permits must specify the number and species of animals that can be taken, and designate the manner (method, dates, locations, etc.) in which the takes may occur. NMFS has sole jurisdiction for issuance of such permits for all species of cetacean, and for all pinnipeds except walrus⁷.

NMFS may issue a permit pursuant to section 104 of the MMPA to an applicant who submits with their application information indicating that the taking is required to further a bona fide scientific purpose. An applicant must demonstrate to NMFS that the taking will be consistent with the purposes of the MMPA and applicable regulations. If lethal taking of a marine mammal is requested, the applicant must demonstrate that a non-lethal method of conducting research is not feasible. NMFS must find that the manner of taking is "humane"⁸ as defined in the MMPA. In the case of proposed lethal taking of a marine mammal from a stock listed as "depleted" NMFS must also determine that the results of the research will directly benefit the species or stock, or otherwise fulfill a critically important research need.

NMFS has promulgated regulations to implement the permit provisions of the MMPA (50 CFR Part 216) and has produced application instructions approved by the Office of Management and Budget that prescribe the procedures (including the form and manner) necessary to apply for permits. All applicants must comply with these regulations and application instructions in addition to the provisions of the MMPA.

1.5.3 *Endangered Species Act*

Section 9 of the ESA, as amended, and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption such as by a permit. Permits to take ESA-listed species for scientific purposes, or for the

⁶ The MMPA defines bona fide research as "scientific research on marine mammals, the results of which – (A) likely would be accepted for publication in a refereed scientific journal; (B) are likely to contribute to the basic knowledge of marine mammal biology or ecology; or (C) are likely to identify, evaluate, or resolve conservation problems."

⁷ The U.S. Fish and Wildlife Service has jurisdiction for walrus, polar bears, sea otters, and manatees.

⁸ The MMPA defines humane in the context of the taking of a marine mammal, as "that method of taking which involves the least possible degree of pain and suffering practicable to the mammal involved."

purpose of enhancing the propagation or survival of the species, may be granted pursuant to Section 10(a)(1)(A) of the ESA.

NMFS has promulgated regulations to implement the permit provisions of the ESA (50 CFR Part 222) and has produced OMB-approved application instructions that prescribe the procedures necessary to apply for permits. All applicants must comply with these regulations and application instructions in addition to the provisions of the ESA.

Section 10(d) of the ESA stipulates that, for NMFS to issue permits under section 10(a)(1)(A) of the ESA, the Agency must find that the permit: was applied for in good faith; if granted and exercised will not operate to the disadvantage of the species; and will be consistent with the purposes and policy set forth in Section 2 of the ESA.

Section 7 of the Endangered Species Act (ESA; 16 U.S.C. 1531 *et seq.*) requires consultation with the appropriate federal agency (either NMFS or the U.S. Fish and Wildlife Service) for federal actions that “may affect” a listed species or adversely modify critical habitat. NMFS issuance of a permit affecting ESA-listed species or designated critical habitat, directly or indirectly, is a federal action subject to these Section 7 consultation requirements. Section 7 requires federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species. NMFS is further required to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any threatened or endangered species or result in destruction or adverse modification of habitat for such species. Regulations specify the procedural requirements for these consultations (50 Part CFR 402).

1.5.4 Animal Welfare Act

The Animal Welfare Act (AWA: 7 U.S.C. 2131 – 2156) sets forth standards and certification requirements for the humane handling, care, treatment, and transportation of mammals. Enforcement of these requirements for non-federal facilities is under jurisdiction of the U.S. Department of Agriculture’s Animal and Plant Health Inspection Service. Each research facility is required to establish an Institutional Animal Care and Use Committee (IACUC) which reviews study areas and animal facilities for compliance with the AWA standards. The IACUC also reviews research protocols and provides written approvals for those that comply with AWA requirements. For federal research facilities, the head of the federal agency is responsible for ensuring compliance with the AWA requirements. It is the responsibility of the researcher to seek and secure IACUC reviews and approvals for their research.

1.5.5 Magnuson-Stevens Fishery Conservation and Management Act

Under the MSFCMA Congress defined Essential Fish Habitat (EFH) as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 U.S.C. 1802(10)). The EFH provisions of the MSFCMA offer resource managers means to accomplish the goal of giving heightened consideration to fish habitat in resource management. NMFS Office of Protected Resources is required to consult with NMFS Office of Habitat Conservation for any action it authorizes (e.g., research permits), funds, or undertakes, or proposes to

authorize, fund, or undertake that may adversely affect EFH. This includes renewals, reviews or substantial revisions of actions.

CHAPTER 2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 Alternative 1 – No Action

Under this alternative, which is the “status quo” alternative, a new permit for scientific research to conduct a behavioral response study on marine mammals in the Pacific Ocean using controlled sound exposure would not be issued. Sounds would not be introduced and none of the study objectives would be met. In the absence of the proposed study, additional information about marine mammals’ response and sensitivity to specific sounds would not be collected or available for use by NMFS in making better informed management decisions. Under this alternative, the effects on a limited number of marine mammals that might result from the controlled sound exposures of the proposed action would not occur.

2.2 Alternative 2 – Proposed Action

Under the Proposed Action alternative, a scientific research permit would be issued to NMFS Office of Science and Technology authorizing takes of marine mammals as described in the application, and as limited by standard and special permit terms and conditions. The proposed permit would authorize the intentional exposure of beaked whales, blue whales, fin whales, gray whales, sperm whales, short-finned pilot whales, short-beaked common dolphins, northern right whale dolphin, California sea lion, and harbor seals to underwater novel synthetic sounds and coherent/incoherent sounds. The proposed permit would also authorize unintentional exposure of a number of other marine mammals under NMFS jurisdiction to simulated MF sonar. Authorized research would include close approach for attachment of instruments, photo-identification, and behavioral observations of target animals. The permit would also authorize collection of skin samples for analysis.

Estimates for the number of takes in each category are developed in section 2.2.3. Visual and passive acoustic monitoring would be implemented to ensure no injurious takes of marine mammals; and there would be clear source shutdown criteria to limit exposure to Level B harassment before any injurious behavioral responses occur.

One important aspect for developing effective mitigation is to test whether different marine mammal taxa are more or less at risk from sonar. It is therefore important to test responses of marine mammal species for which there is little evidence of risk (e.g., mysticetes, pinnipeds, and some of the smaller odontocetes), in addition to those that may have some particular sensitivity and are thus high priority species. Reports of atypical strandings of beaked whales during naval sonar exercises have raised particular concern about effects of sound on these species (Cox *et al.*, 2006), as well as conclusions that they may be particularly sensitive species (e.g., Southall *et al.*, 2007; Boyd *et al.*, 2007; 2008). However, additional measurements are clearly required, including measurements of additional beaked whale species and in different geographical locations; each of these factors argues strongly for beaked whales being the primary target species within the studies involved in the SOCAL BRS studies being proposed here.

While the evidence for a link between sonar and stranding is much weaker for any other marine mammals than for beaked whales, the lack of direct empirical measurements and several uncertain situations involving strandings of other species coincident with sonar exercises (e.g., melon-headed whales, Southall *et al.*, 2006; pilot whales, Hohn *et al.*, 2006) raise the importance of also testing responses of other species. Further, even if there is little or no risk of injury or stranding from sonar in mysticetes, pinnipeds, or non-beaked whale odontocetes, there are likely to be behavioral reactions of various types in these animals to underwater sounds such as those involved in military sonar training. Given that behavioral responses are likely under some conditions and that there are currently few applicable data by which to predict the type and magnitude of such responses for environmental assessments, several species of each taxa are included within the studies under the proposed action. Plans are for beaked whales, blue whales, fin whales, gray whales, sperm whales, short-finned pilot whales, short-beaked common dolphins, northern right whale dolphin, California sea lion, and harbor seals to be the primary subjects for tagging during the study to be conducted in the U.S. Navy SOCAL Range Complex, near the vicinity of San Clemente Island (SCI). Responses of other cetaceans and pinnipeds may also be monitored as possible, using focal follow techniques (which are further defined in this subchapter), including visual and acoustic monitoring. The subjects would be purposefully exposed to natural and artificial underwater sounds and quantify exposure conditions associated with various effects.

The proposed action provides for research that is designed to measure baseline (normal) behavior in marine mammals, including but not limited to acoustic and diving behavior, as well as changes in their behavior as a function of exposure to different sounds. Consequently, there are different elements to the study to measure behavior before, during, and after controlled exposures to different sounds. Specialized, inter-disciplinary teams of scientists would conduct the various project functions, including: locating and identifying target species and individuals suitable for tagging; attaching and tracking acoustic tags on individual marine mammals; safely conducting playback experiments with established mitigation measures; monitoring and tracking focal individuals (and those exposed incidentally, as possible). The proposed action procedures are very similar to and consistent with those used in the Bahamas BRS efforts (see Boyd *et al.*, 2007; 2008; Southall *et al.*, 2007) and also work conducted under other permits on the NATO research vessel Alliance in the western Mediterranean Sea by Tyack, Southall, D'Amico and others.

The exposure range for the study would be selected to include exposures associated with changes in behavior of beaked whales at the Navy's underwater ranges near SCI. One of the benefits of conducting the tests on an undersea range where beaked whales can be acoustically monitored with permanent seafloor hydrophones is that it is possible to assess exposures where there is no noticeable change in location and timing of foraging dives vs. exposures associated with changes in behavior, such as avoidance or cessation of vocalization. Data from the underwater range, collected during range exercises involving underwater MF sound and during control periods (no underwater anthropogenic sound) would help define exposures at the onset of beaked whale click cessation, which would be factored into the minimum animal RL for Phase I playbacks.

2.2.1 Types of Approaches and Follows

The different ways in which animals might be taken involve close approach (CA), tag attachment (TA), and playback (PB).

Close approach (CA) – A close approach is defined as a continuous sequence of maneuvers (episode) involving a vessel, aircraft, or researcher’s body in the water, including drifting, directed toward a cetacean or group of cetaceans for the purposes of conducting authorized research, [including approaches to <10-15 m to allow for tag attachment and/or photo-identification], which involves one or more instances of coming closer than 100 yards to the cetacean or group of cetaceans. Animals need to be approached to <10-15 m for tag attachment. This would be done in a way to maximize the success of tagging while minimizing disruption, specifically: slowly, deliberately, and for as short a time as possible.

Tag attachment (TA) - Tag attachment would be conducted so as to minimize the potential for disturbing the whale. The proposed method to attach tags involves using a hand-held carbon fiber pole several meters in length and approaching the animals slowly in small 3-5 m vessels or using a 12+m cantilevered pole deployed from a medium sized RHIB, inflatable, or rigid hulled vessel. In some settings, such as with bow-riding dolphins, it may be preferable to use a vessel that is fast enough for dolphins to bow-ride. If necessary, proven remote attachment methods might be used for species or contexts where the pole attachment is thought to involve a higher risk of disturbance and/or a greatly reduced likelihood of tag attachment.

Playback (PB) – Playback experiments (i.e., controlled exposure experiments, or CEE) are proposed for a variety of marine mammal species in and near the SCORE range in Southern California. All of these playbacks would use an underwater speaker deployed from a vessel, projecting a variety of natural (e.g., killer whale sounds) and man-made sounds (e.g., simulated military active mid-frequency sonar and pseudo-random noise). The vessel-based PBs may involve a stationary source of sound, or the source vessel may move in relation to the subject(s) in a controlled manner. There would be one or more designated focal animal subjects for each of these playbacks, which would only occur after baseline behavior of a subject has been collected. Playback takes would include both those of focal individuals and incidental exposures to non-focal individuals (in either the focal group or in the general area). During a playback, the playback vessel may maneuver to stay near the focal animal, but the vessel would attempt to stay 1km or further from the focal animal (and a minimum of 200m) so that the visual stimulus of the ship or acoustic stimulus of the source are less likely to be sensed by the subject. The maximum received level (RL) at the animal subject would be set well below levels that might cause injury by maintaining this range during playbacks and limiting the maximum sound output level. Specifically, the proposed action calls out a maximum source level of 220 dB re: 1 μ Pa (RMS) to result in no greater than a maximum RL at the whale of 180 dB re: 1 μ Pa for underwater sounds. All reasonable precautions are to be taken in controlling the source level (SL) of the PBs to ensure the RL at the animal would not exceed the maximum RL above, including a mandatory shut-down of source transmissions if the focal animal or any other marine mammals are seen within 200m of the source. Before starting each PB, the range to the animal subject would be estimated using passive acoustic monitoring or visual sighting data and the SL would be adjusted to achieve a specified RL at the animal. Each playback sequence would start with a SL selected to yield a RL well below the maximum. The SL (and presumably RL) would then be gradually

increased at the animal while responses are being monitored until either a response is observed or the maximum planned exposure is reached. The playbacks would follow a specified protocol to ensure that the focal animal is only exposed to a level sufficient to evoke a response and to minimize the chances that non-focal animals would be incidentally exposed to received levels above that of the focal. After the playback has been completed, either the playback vessel or a different tracking vessel would follow the focal whale in order to collect post-exposure control data.

2.2.2 Recap of Research Objectives

As previously discussed in subchapter 1.1.2, the research objectives include:

Objective 1: Vocal communication in cetaceans: what are the types and characteristics of vocal signals produced by different species, and what are their communicative and echolocation functions? (Requires tags, but no PBs)

Objective 2: How do marine mammals respond to the sounds of a common predator, the killer whale (*Orcinus orca*)? (Requires tags and PBs)

Objective 3: How do marine mammals respond to sonar and other sounds? What are the types and contexts of exposure resulting in different kinds of behavioral responses in different species? Can these responses be related to risk factors for more severe behavioral responses and/or injury? Are there particularly sensitive and generally tolerant marine mammal species with regard to acoustic exposure? (Requires tags and PBs)

2.2.3 Categories of Take

Take Category 1: Estimating the number of animals taken by close approach, tag attachment, photo-identification, focal follow, and playback during the course of the proposed research activity

The values in this category represent the maximum number of playbacks to tagged individuals for each species. Only animals that are successfully tagged, focal followed and presented with a playback stimulus are included in this category. Under the proposed action, the notional maximum number of playbacks is 20 tagged animals per target species per year for the research objectives involving playback (objectives 2 and 3). Some of the playback stimuli are of particular value when responses are compared to the same subject exposed to more than one stimulus type. For example, the research attempts to determine whether changes in behavior are just as likely to be caused by specific exposure to any stimulus or whether the same individual is more or less likely to respond to different stimuli. A playback of such a sequence of stimuli during the same focal follow would be considered to be one playback, just as a sequence of close approaches is considered to represent one close approach. For longer duration tag attachments (as expected to be possible with the development of the 3rd-generation DTAGs), exposures to the same focal animal on subsequent days would be considered to be additional playbacks (and thus subsequent takes). Given these considerations and the known limitations involving this kind of research in the field, the applicant considered it reasonable to request a total of 20 playbacks per year from each of the target species.

The target species involved in this category of takes include: blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), gray whale (*Eschrichtius robustus*), sperm whale (*Physeter macrocephalus*), Cuvier's beaked whale (*Ziphius cavirostris*), Baird's beaked whale (*Berardius bairdii*), Blainville's beaked whale (*Mesoplodon densirostris*), short-finned pilot whale (*Globicephala macrorhynchus*), short-beaked common dolphin (*Delphinus delphis*), Northern right whale dolphin (*Lissodelphis borealis*), California sea lion (*Zalophus californianus*), and harbor seal (*Phoca vitulina*). Most of the target species have been tagged successfully with DTAGs or BProbes in previous research or are thought to be good candidates for this research effort. Adults and juveniles of either sex may be taken. Practically speaking, it is not possible that 20 playbacks would be conducted on all of these species. However, due to the nature of field work, and the particular difficulty in the kinds of studies being proposed here, researchers cannot predict a priori which species would be encountered frequently enough to come near this limit. Therefore the application lists all of these species as potential candidates for up to 20 playbacks per year, recognizing that the actual number would likely be well below this total possible value.

The goal of each playback is to add a new subject to the sample, or in the case of tagged individuals over subsequent days to investigate any changes in response following repeated exposures. For both reasons, every effort would be made to check the photo-identification of candidates for tagging against a catalog of the animals previously subjects in playback experiments. If there is any indication that a candidate has already been a subject of a previous tag attachment and playback, the tagging team would redirect their efforts to identifying a different subject for tagging. However, over a potentially 4-6 month field season (depending on weather conditions), it is possible that the same individual animal may be exposed (either intentionally or incidentally) to several playbacks.

During a typical day involving this category of take, research vessels would start in search mode, with all available passive acoustic capabilities monitoring the study area before daybreak for sounds typical of each species. Once there was enough daylight, visual monitors would begin scanning for target species and the principal and co-investigators would assess the environmental conditions to assess whether they would be suitable for possible tagging and playback efforts. Once one of these species was detected, if this group was selected, the visual and acoustic observer teams would switch to a focal follow mode, with continuous observation for the focal individual or group. If conditions were appropriate, the tag boat and tag team would be deployed for tagging. The observers would maintain radio communication with the tag boat, to help them maneuver near the focal group. If a tag is successfully attached and individuals photo-identified, the tag boat would stop following the focal group, and the follow would be continued at a distance using the larger research vessel to minimize potential disturbance from the vessels. After suitable pre-exposure data were collected, and if the visual and acoustic observer teams were able to estimate range from the ship to the focal individual sufficiently well, the sound source would be deployed, stimulus selected, and the sound would be played back following the playback protocol. After playback ceased, acoustic and visual teams would monitor behavior post-playback. If the protocol called for additional playback stimuli, and the subject appeared to be back to baseline behavior, another controlled exposure of sound might be conducted. After the playback sequence, the ship would follow the tagged whale until the tag released from the animal, at which point the tag would be located and retrieved. The only possible deviation from

this approach might be in the case of eventual longer-term deployment of DTAGs where focal groups might not be followed explicitly for the entire duration of deployment, but the tags would be retrieved on subsequent days. Once retrieved, tags would then undergo post-deployment calibration, and the data would be downloaded immediately. As soon as the data were available, the tag team would analyze the tag data for a quick-look assessment of behavioral responses and acoustic exposure for discussion among the principal and co-investigators in consideration of how to proceed with subsequent CEEs.

Category 2: Estimating the number of animals that may be taken by close approach, photo-identification, tag attachment, and focal follow (but no playback) during the course of the proposed research activity

Research objective 1 calls for tagging of cetaceans, but not conducting playbacks. For the proposed research objectives 2 and 3, which do involve playback, it is imperative to obtain baseline data from animals that are tagged but not exposed to experimental playbacks, in order to more effectively analyze and interpret the controlled exposure results (e.g., Boyd *et al.*, 2007; 2008). Data can be collected for each of these three objectives with tags attached to the relevant species in non-playback situations. Since control data are so important, the numbers requested here for the combination of objectives 2 and 3 is the same as the playback goal of 20 takes per year for most species. The total number of Category 2 takes is increased by an additional 40 takes per year for those species where researchers would like to tag several animals simultaneously within the group to analyze how acoustic communication is used during social interaction (e.g., pilot whales, most delphinids, and the mysticetes).

Adults and juveniles of either sex may be taken for all of these species. As with playbacks, the goal of most tagging is to study a larger sample of different individual animals, meaning that most of the effort would be devoted to not taking the same individual more than once. However, many of these studies require the tag to be attached for a sufficient duration; if the tag releases prematurely, there may be effort to reattach the tag to the same individual on the same day. However, researchers would conduct no more than tag attachments per individual per day. For studying the stability of the vocal repertoire over time and in different contexts, there would be an advantage in tagging the same individual several times within the same year. Additionally, some individuals that are not particularly recognizable through natural markings may not be recognized as having been tagged earlier, so there is a small possibility for repeat tagging due to this possibility. Thus, either intentionally or inadvertently, the same individual animal may be repeatedly tagged up to three times a day over several days within a year.

A summary of estimated Category 2 takes is provided by Table 2-1.

Table 2-1: Category 2 - Tag Takes with no playback (per annum)

Common Name	Scientific Name	Research objectives requiring Tag Takes (no PB)	Number of Tag Takes (Tagging Goal, no PB)
Blue whale	<i>Balaenoptera musculus</i>	1(20+40), 2&3(20)	80
Fin whale	<i>Balaenoptera physalus</i>	1(20+40), 2&3(20)	80
Gray whale	<i>Eschrichtius robustus</i>	1(20+40), 2&3(20)	80
Sperm whale	<i>Physeter macrocephalus</i>	1(20), 2&3(20)	40
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	1(20), 2&3(20)	40
Baird's beaked whale	<i>Berardius bairdii</i>	1(20), 2&3(20)	40
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	1(20), 2&3 (20)	40
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	1(20+40), 2&3(20)	80
Short-beaked common dolphin	<i>Delphinus delphis</i>	1(20+40), 2&3(20)	80
Northern right whale dolphin	<i>Lissodelphis borealis</i>	1(20+40), 2&3(20)	80
California sea lion	<i>Zalophus californianus</i>	1(0), 2&3(0)	0*
Harbor seal	<i>Phoca vitulina</i>	1(0), 2&3(0)	0*

* Tagging of pinnipeds, if done, would be done under previously issued SRP 87-1851 and/or subsequent modification to the current permit.

Category 3: Estimating the number of animals that may be taken by close approach, photo-identification and focal follow (but no tagging or playback) during the course of the proposed research activity

For the proposed research objectives, important data can be obtained from animals through visual or passive acoustic monitoring, even if they are not tagged. This category of take estimates the number of animals that may be taken by close approach, photo-identification, and focal follow but where no tagging took place due to one of the following cases:

- 1) The animal was simply among the same local group (subgroup) that was closely approached as the animal that was targeted for being tagged. Many of the species that are proposed for tagging are social. A close approach to one animal for tagging would result in a close approach to multiple animals. For species that travel in large groups, this case

would represent the majority of the CA takes counted under this particular category. The total number of CA takes within this case would depend on the overall number of tagging attempts and the relative group (subgroup) size.

2) An animal was approached for tagging, but the tagging attempt was unsuccessful and no tag actually touched the animal. This depends, in part, upon the estimated tagging success rate and the goal number of tags per species to be attached.

3) An estimated number of close approaches for photo-identification and behavioral observation where tagging is not attempted. Or,

4) After close approach for tagging, it was determined that the target animal had been previously tagged and subsequent tagging was called off. In this last case, the researchers might elect not to tag any other animal in the group but rather to locate a different group.

Group size for marine mammals at sea is often defined as all of the animals that can be sighted together. An estimate of group sizes is included with the information provided in Table 3-2. For estimating CA takes, it is more appropriate to consider smaller subgroups within 100 m of the vessel. If a smaller subgroup size is considered to be appropriate for a species, this is indicated in parenthesis after the group size listed in Table 3-2. As the group / subgroup size increases in number, this size becomes the primary determinant for the number of takes in this particular category. To estimate the number of close approach takes, first the maximum number of tagging attempts was estimated based on the tagging goals listed in Table 2-1 in combination with the estimated tagging success rate. This maximum number of tagging attempts is then multiplied by the number of animals anticipated to be in the local subgroup to obtain the number of close approach takes. It is recognized that some of these tagging attempts would actually result in successful tag attachments (which were previously counted as Category 2 Takes), however they were conservatively included in the take estimates here in part to account for the very limited number of takes in cases 3 and 4 cited above.

Adults and juveniles of either sex may be taken for all of these species. When a group is first sighted from a distance, it is difficult to tell whether the animals have been previously approached unless there are very well marked individuals. In this case, a close approach (and thus a CA take) is required to identify individual animals. Therefore, it is possible that the same group may be approached several times on the same day or on different days. However, there are only a limited number of close approaches that the researchers make within a day. In practice with this type of field work, the research scientists may follow a group for much of a day with several instances of approaches within 100m. However, it is not common for them to leave a group and then reapproach it again on the same day. For field research based in one area, it is possible to approach and re-identify the same individual on different days. These re-sight data are critical for mark-recapture analysis of photo-identification data, so they have significant scientific value. In keeping with the above field work practices, it is possible although rare that the same individual animal may be approached more than once on the same day. For purposes of estimating CA approaches, it is conservatively estimated that the same individual animal may be approached up to 20 times during one year.

Table 2-2: Category 3 - Close Approach Takes with no tagging and no playback (per annum)

Common Name	Scientific Name	B. Number of Tag Takes (Tagging Goal, no PB)	C. Est. tagging success rate	D. Max # of tagging attempts: (B/C)	E. Sub-group size	F. CA takes (D x E)
Blue whale	<i>Balaenoptera musculus</i>	80	0.7	114	2	228
Fin whale	<i>Balaenoptera physalus</i>	80	0.7	114	3	342
Gray whale	<i>Eschrichtius robustus</i>	80	0.7	114	3	342
Sperm whale	<i>Physeter macrocephalus</i>	40	0.7	57	1.5	86
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	40	0.2	200	3	600
Baird's beaked whale	<i>Berardius bairdii</i>	40	0.2	200	7	1400
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	40	0.2	200	4	800
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	80	0.6	133	22.5	3000
Short-beaked common dolphin	<i>Delphinus delphis</i>	80	0.3	267	30	8000
Northern right whale dolphin	<i>Lissodelphis borealis</i>	80	0.3	267	12.4	3307
California sea lion	<i>Zalophus californianus</i>	0*	n/a	0	3	0
Harbor seal	<i>Phoca vitulina</i>	0*	n/a	0	2	0

Category 4: Estimating the number of animals that may be taken by intentional playbacks to non-tagged animals

The DTAG provides the primary method for measuring acoustic exposure and recording behavioral responses from playbacks. However, many of the species researchers propose to tag for playbacks are social and any playback directed at one or a few tagged members of a group are likely to lead other members of the group to be exposed as well. Visual observers and passive acoustic monitoring would be able to track responses of these untagged animals that are involved in intentional playbacks to tagged animals within the group. Thus, researchers would count any untagged animals in the group of one or more animals tagged for playback to be included in this intentional playback to untagged animals category. For some of the species to be studied here, it is possible to observe responses to playback by combining visual observations of untagged animals at the surface with passive acoustic monitoring. This is not practical for untagged beaked whales, which spend most of their time at depth and are often difficult to follow between dives, but can be done for delphinids such as pilot whales or smaller pelagic dolphins that form groups that are easily followed visually from a vessel. If an individual within the group has a very distinctive natural marking, it may be possible to conduct an individual follow, but most of the time this method would involve a group follow. Visual observations, when feasible, coupled with acoustic monitoring of group vocalizations using hydrophones, should provide a good indication of the track of the group, along with categorization of group behavior and cohesion. Repeated photo-identification should also help to quantify stability of association patterns during the follow. Therefore, the proposed action also suggests for the relevant species that up to half of the total proposed playbacks could be to untagged animals.

Adults and juveniles of either sex may be taken. However, there would be every effort to make sure that no neonate is exposed; if a neonate is sighted, the group would not be subject for a playback. Thus every effort would be made to check the candidate groups for the presence of a neonate and no playback would be considered until there was confidence that no neonate was present. The goal of each playback is to add a new subject to the sample. Thus every effort would be made to check the photo-identification of candidates against a catalog of the animals previously subjects in playback experiments. If there is any indication that a candidate has already been a subject, the team would redirect their efforts to a different subject. However, over one 4-6 week cruise per year, it is possible that the same individual animal may be exposed to several playbacks.

Table 2-3 provides the annual take estimates for intentional playbacks to non-tagged animals under the proposed action alternative.

Table 2-3: Category 4 - Intentional Playback Takes with no tagging (per annum)

Common Name	Scientific Name	B. Group Size	C. Goal # of Playbacks	D. Number of non-tag playback takes when animal in group is tagged (B-1)*C	E. Max # Playbacks to non-tagged animals	F. Max Number of Playbacks where no animal is tagged	G. Grand Total of non-tagged playback takes (D+F)
Blue whale	<i>Balaenoptera musculus</i>	2	20	20	0	0	20
Fin whale	<i>Balaenoptera physalus</i>	3	20	40	0	0	40
Gray whale	<i>Eschrichtius robustus</i>	3	20	40	0	0	40
Sperm whale	<i>Physeter macrocephalus</i>	5	20	80	0	0	80
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	2	20	20	0	0	20
Baird's beaked whale	<i>Berardius bairdii</i>	7	20	120	0	0	120
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	4	20	60	0	0	60
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	22.5	20	430	10 of 20 in C	10	440
Short-beaked common dolphin	<i>Delphinus delphis</i>	354	20	7060	10 of 20 in C	10	7070
Northern right whale dolphin	<i>Lissodelphis borealis</i>	12.4	20	228	0	0	228
California sea lion	<i>Zalophus californianus</i>	3	20	40	0	0	40
Harbor seal	<i>Phoca vitulina</i>	2	20	20	0	0	20

Category 5: Estimating the number of animals that may be taken by unintentional exposure to Playback

The subject of each PB experiment is the target animal(s), but animals other than the target animals may also be unintentionally exposed to the playback of underwater sound signals. The total number of estimated unintentional PB takes (incidental takes) for each species is based upon an estimate of the number of animals that might be present without being sighted or otherwise detected within the zone of predicted harassment during all the playbacks planned for each year. This estimate is based upon the maximum number of playbacks expected for each year, the group size of the species, an approximate category for the density for the species, and an estimate of the likelihood of sighting the group before it comes within the zone of predicted take.

The method used to estimate the number of incidental playback takes first assumes that if non-target animals are sighted, either of two things would happen. If the non-target animals can be monitored as playback subjects and they have been authorized under the proposed action for intentional exposure, they may purposefully become additional intentional playback subjects and thus counted as a Category 4 Take. However, if the sighted non-target animals are not authorized for intentional exposure, the playback would be stopped. Additionally, if any of the sighted animals enter the established shutdown zone (conservatively defined as 200m), the playback would be stopped to prevent any possible injury.

It would be problematic if a group of animals happened to surface within the harassment take zone that had a large enough group size to exceed the estimated take. Therefore, in computing the Category 5 estimate, an alternative estimate for the number of takes is given as twice the estimated group size. The final estimate for incidental playback take is then the larger of the two estimates. While the proposed action alternative accounts for the researcher's stated desire to conduct up to 20 playbacks per species with a range of species, the ability to conduct playbacks would certainly be limited by the species and groups encountered in appropriate conditions. Consequently, a generous upper limit to the number of total playbacks that could be conducted annually including all species under this permit is given as 100.

This project is intended to specifically help determine and assess contexts and levels of exposure causing behavioral disturbance in the target species. A major goal of the proposed research is to help inform acoustic criteria (such as Southall *et al.*, 2007) that describe or predict changes in behavior considered to constitute harassment. In the absence of such data, and in keeping with current NMFS practice, reporting would be required for all marine mammals sighted within a range from the source vessel during PBs where the animal RL is predicted to be 160 dB re: 1 μ Pa in a tally of animals used to estimate potential unintentional harassment takes (NMFS 2005).

To cover the possibility of unintentional exposure during PB, the proposed action alternative includes potential takes by harassment of marine mammal species that may be present in the research area. The details of where an animal would be exposed to 160 dB SPL or above depends upon its depth, range and how sound is propagating through the ocean. To make a general estimate that takes source level and general features of sound propagation into account, this estimate is based upon spherical spreading loss (Urick 1983). This assumes that sound is spreading evenly in a homogeneous medium. Sound propagation is well-known to be much

more complex where the ocean is not homogenous, but the sonar equation would still give a reasonable estimate of the volume of water ensonified for the short ranges out to the 160 dB SPL level for the relatively low-level playbacks to be conducted in this research program. The estimated range out to the 160 dB SPL isopleth used for this spherical spreading analysis is 1000 m. This estimate is made for a maximum SL of 220 dB SPL for an omni-directional source in the horizontal, which is higher than any of the underwater horizontally omni-directional acoustic sound sources being considered for use for the proposed playback research.

One way to reduce exposure of animals other than the tagged animal being tested is to use a source that is directional in both the vertical and horizontal. The actual sonars linked to strandings use arrays of sound sources to direct the sound beam. If it becomes possible to use such a directional sound source, the source level would be adjusted so that the volume ensonified is no larger than that of a 220 dB omnidirectional source. The analysis described here also assumes that each playback would increase exposure to the maximum level, but in fact playbacks would cease increasing source level when a defined response (e.g., cessation of vocalization) is detected. Therefore, and considering that the proposed action is extremely unlikely to achieve the upper bound of 100 total playbacks annually, the estimates of incidental harassment takes for the non-target species are likely significant over-estimates.

Table 2-5 details the estimated number of animals that may be unintentionally exposed to playback. This would occur if animals were in the area (defined as ≤ 1 km from the source) and undetected. The potential number of playback takes are estimated by first estimating the number of animals that might be within the 1 km radius based upon the expected density of animals of that species and then multiplying that by the probability that they would not be sighted.

The details of the calculations, which are shown in Table 2-5, are as follows:

- 1) The maximum possible number of playbacks for all species annually is estimated to be 100.
- 2) A representative group size of each species for the area is listed in column B. The source of the estimate is provided by Table 3-2.
- 3) Quantitative estimates of the seasonal density of species are given in column D. This is then used to assign a value for the “Probability of being present” shown in Column E. This value is assigned a numerical value for the “Probability of being present” using the following conversion.

Table 2-4: Conversion table for "Probability of being present"

Probability of being present	Seasonal density (highest value) / km ²	Assigned numerical value
High	> 0.5	1.0
Medium	0.05 – 0.5	0.5
Low	0.003 – 0.05	0.05
Very Low	0.0005 – 0.003	0.005
Rare	< 0.0005	0.0005

- 4) Finally, an assessment is made of the species-specific probability of detection. Quantitative values for probability of detection if an animal is within 1 km are not available for most species, and where available, would depend upon sea conditions and visibility, among other factors. The numbers listed here are qualitative estimates from experienced field biologists working on these species in many areas, including the study location. The estimates are based upon the size of the individual (the larger the animal, the more likely to detect), the size of the group (the larger the group, the more likely to detect), the frequency of surfacing, and the visibility of surface behavior. These estimates for the distance at which presumably sensitive and hard-to-sight species (e.g., beaked whales) also take monitoring for vocalizations into account.
- 5) Column F is the probability of detection of the presence of the species within the zone of predicted impact. The formula for calculating the number of incidental exposures is:

$$100 \times B \times E \times (1-F)$$

Table 2-5: Category 5 - Unintentional Exposure Takes to Playbacks by non-tagged animals (per annum)

Common Name	Scientific Name	Assumed Mean Group Size (Col B)	SOCAL Highest Seasonal Density density/km ² (Col D)	Assumed value for Probability Being Present in SOCAL (Col E)	Probability of Detection within 1 km (Col F)	Estimated Incidental Takes	Group Size x 2	Greater of Calculation and Group Size Estimate (rounded up)
MYSTICETES								
Blue whale	<i>Balaenoptera musculus</i>	2	0.0041222	0.05	0.9	1	4	4
Fin whale	<i>B. physalus</i>	3	0.0024267	0.005	0.9	0.15	6	6
Sei whale	<i>B. borealis</i>	3	0.0000081	0.0005	0.9	0.015	6	6
Bryde's whale	<i>B. edeni</i>	1.5	0.0000081	0.0005	0.9	0.0075	3	3
Minke whale	<i>B. acutorostrata</i>	1	0.0010313	0.005	0.9	0.05	2	2
Humpback whale	<i>Megaptera novaeangliae</i>	1	0.0001613	0.0005	0.9	0.005	2	2
Gray whale	<i>Eschrichtius robustus</i>	3	0.051**	0.5	0.9	15	6	15
ODONTOCETES								
Sperm whale	<i>Physeter macrocephalus</i>	5	0.0014313	0.005	0.9	0.25	10	10
Pygmy sperm whale	<i>Kogia breviceps</i>	1	0.0013785	0.005	0.1	1.575	7	7
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	2	0.0036883	0.05	0.1	9	4	9

Common Name	Scientific Name	Assumed Mean Group Size (Col B)	SOCAL Highest Seasonal Density density/km ² (Col D)	Assumed value for Probability Being Present in SOCAL (Col E)	Probability of Detection within 1 km (Col F)	Estimated Incidental Takes	Group Size x 2	Greater of Calculation and Group Size Estimate (rounded up)
Baird's beaked whale	<i>Berardius bairdii</i>	7	0.0001434	0.0005	0.1	0.315	14	14
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	4	0.0011125	0.005	0.1	1.53	6.8	7
Killer whale	<i>Orcinus orca</i>	7	0.0000812	0.0005	0.9	0.035	14	14
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	22.5	0.0003315	0.0005	0.9	0.1125	45	45
Risso's dolphin	<i>Grampus griseus</i>	13.5	0.0540134	0.05	0.9	6.75	27	27
Bottlenose dolphin	<i>Tursiops truncatus</i>	18.8	0.0184808	0.05	0.9	9.4	37.6	38
Striped dolphin	<i>Stenella coeruleoalba</i>	37.3	0.0175442	0.05	0.9	18.65	74.6	75
Pacific white-sided dolphin	<i>Lagenorhynchus obliquidens</i>	14	0.0160748	0.05	0.9	7	28	28
Short-beaked common dolphin	<i>Delphinus delphis</i>	354	0.8299606	1	0.9	3540	708	3540
Long-beaked common dolphin	<i>Delphinus capensis</i>	12	0.0965747	0.5	0.9	60	24	60
Northern right whale dolphin	<i>Lissodelphis borealis</i>	12.4	0.0270163	0.05	0.9	6.2	24.8	25
Dall's porpoise	<i>Phocoenoides dalli</i>	3.4	0.0081008	0.05	0.5	8.5	6.8	9

Common Name	Scientific Name	Assumed Mean Group Size (Col B)	SOCAL Highest Seasonal Density density/km ² (Col D)	Assumed value for Probability Being Present in SOCAL (Col E)	Probability of Detection within 1 km (Col F)	Estimated Incidental Takes	Group Size x 2	Greater of Calculation and Group Size Estimate (rounded up)
CARNIVORES - Pinnipeds								
Northern fur seal	<i>Callorhinus ursinus</i>	2	0.027	0.05	0.5	5	4	5
Guadalupe fur seal	<i>Arctocephalus townsendi</i>	2	0.007	0.05	0.5	5	4	5
California sea lion	<i>Zalophus californianus</i>	3	0.87	1	0.5	150	6	150
Northern elephant seal	<i>Mirounga angustirostris</i>	2	0.042	0.5	0.1	90	4	90
Harbor seal	<i>Phoca vitulina</i>	2	0.19	0.5	0.5	50	4	50
Stellar sea lion	<i>Eumetopias jubatus</i>	2	0	0.0005	0.5	0.05	0***	0
CARNIVORES - Mustelid								
Southern Sea Otter	<i>Enhydra lutris nereis</i>	2	Few sea otters venture beyond 1 mile from shore	0.0005	0.1	0.09	4	4
** applies to January-April only *** Stellar sea lion VERY RARE, not expected to be seen in SOCAL RANGE								

2.3 Alternatives Considered but Eliminated from Detailed Study

Issuance of permits is in response to receipt of an application, so the decision to be made is whether or not the proposed activities are consistent with applicable statutory and regulatory issuance criteria. Thus, NMFS typically only evaluates two alternatives in EAs for issuance of research permits under the MMPA and ESA: the no action alternative (deny the permit) and the proposed permit alternative. The proposed permit alternative typically corresponds to the activities proposed in the permit application. This usually represents bookends on the spectrum of possibilities that would not violate the MMPA's or ESA's prohibitions on takes and would be consistent with the purpose and policy of the MMPA and ESA.

Other alternative study designs considered by the applicant but not put forward in their permit application included: 1) other locations for conducting SOCAL BRS; 2) alternate season; 3) not using the endangered blue, fin, or sperm whales in the study; 4) limiting animal age classes, and 5) lower source levels. The following is an explanation of why the applicant did not propose different locations, seasons, species, age classes, or source levels.

Other Pacific locations considered were other locations where the U.S. Navy routinely operates using mid-frequency sonar, including the Hawaii Range Complex, Northwest Training Range Complex, Gulf of Alaska, and the Marianas Range Complex. However, the SOCAL Range Complex location was selected for the Phase I research described in the proposed action alternative based on its unique resource - an array of 84 hydrophones located on the seafloor at the Southern California ASW Range (SOAR). While the existing hydrophones on SOAR are currently bandwidth limited to 8 – 40 kHz, planned updates and refurbishment of this passive array are scheduled for summer 2009. These updates would increase hydrophone bandwidth to ~50 Hz – 40 kHz. This would enable marine mammal monitoring on Navy Ranges (M3R) software that can detect, locate, and display odontocete clicks and whistles. The M3R system works well to locate the sounds of sperm whales and dolphins. With the modification of hydrophones to cover a wider frequency band, it would presumably also work well for large whales and pinnipeds.

The availability of the range, assets, sources, personnel, and the need to conduct the study during a season when there would presumably be sufficient animals determined that the study should be conducted in the summer to fall months of 2010.

Not including endangered whale species (blue, fin, and sperm), and limiting animal age classes were not proposed because, if this research, as anticipated, helps in the formulation/modifications of regulations improving the protection of ESA or MMPA species from noise exposure, then this would help the stocks benefit, as individual animals are protected by monitoring and mitigation measures and as acoustic habitat degradation is reversed. In this context, it is essential to work with those species thought to be most sensitive. It would not be conservative to develop a policy based upon data from less sensitive species and then apply it to more vulnerable ones.

The proposed research includes three species that are currently listed by the U.S. as endangered: blue, fin, and sperm whales. The NMFS published a Recovery Plan for the Blue Whale (*Balaenoptera Musculus*) in July 1998 (NMFS 1998) and separate Draft Recovery Plans For the Fin Whale (*Balaenoptera physalus*) and for the Sperm Whale (*Physeter macrocephalus*) in June 2006 (NMFS 2006a, 2006b). One of the key features of the proposed recovery plans is to “determine and minimize any detrimental effects of anthropogenic noise in the oceans”. The proposed research directly addresses this objective. Additionally, while the beaked whales are not listed as endangered or threatened under the ESA, nor are they identified as strategic stocks, there is only limited information available on the structure and size of their populations. In discussing the status of stock for California/Oregon/Washington stocks of Cuvier’s and Mesoplodont beaked whales, the NMFS 2008 Stock Assessment (Carretta *et al*, 2008) points out that:

“...in recent years questions have been raised regarding potential effects of human-made sounds on deep-diving cetacean species, such as Cuvier’s / Mesoplodont beaked whales (Richardson *et al*. 1995). In particular, active sonar has been implicated in the mass stranding of beaked whales in the Mediterranean Sea (Frantzis 1998) and more recently in the Caribbean (U.S. Dept. of Commerce and Secretary of the Navy 2001).”

The proposed research begins to specifically address the questions regarding the potential effects of human-made sounds on these deep-diving species. Furthermore, the collected data would also be used to assess species differences in vocal behavior that might be used to better identify presence and possibly abundance of these species.

This same logic can be applied to animal age classes within a population. For example, dependent sperm whale young may be seen as a particularly vulnerable component of the population. Whitehead (1996) points out that calves may remain near the surface as adults dive and adults are reported to stop clicking in response to man-made underwater noise. If adults fall silent when an anthropogenic underwater sound starts, juveniles might not be as effective at keeping contact with members of their group. This concern highlights the importance of attending to these potentially most vulnerable members of a population that are likely to be affected by man-made noise. The scientific research team would pay particular attention during the PBs to any animal silencing responses and visual observers would pay particular attention to sighting and following any young animals in a group. Following the principle of special monitoring of vulnerable elements of a population, if researchers are easily able to tag sperm whale juveniles with no more than minor responses from any of the animals, the permit applicant proposes to attempt to do so to test whether their behavior is affected or whether they are affected by changes in the behavior of the adults around them.

Conducting the controlled exposure experiments with a source that has a maximum source level substantially lower than 220 dB at full-power operation was not proposed. While a lower overall source level would limit the volume in which a non-target animal might receive an unintentional exposure to Receive Levels (RLs) over 160 dB, in turn there may be little to no response observed in the targeted species unless the target animals are very closely approached. This runs the risk of contaminating the results with contextual proximity from the source and source platform. Lower source levels also do not replicate the type of exposures that regulators are being asked to assess for potential harm. Previous results from BRS research in the Bahamas during 2007 and 2008 using a

source similar to the one proposed for this research demonstrated that appropriate protocols can be put in place and used to carefully control and monitor animal exposures, and thereby control the associated risks while also collecting the information needed to advance the scientific base.

CHAPTER 3. AFFECTED ENVIRONMENT

This chapter presents baseline information necessary for consideration of the alternatives, and describes the resources that would potentially be affected by the alternatives. The effects of the alternatives are discussed in Chapter 4.

It is anticipated that over the course of research, the proposed activities would be conducted in multiple locations throughout the Pacific Ocean. However, the first year's effort would be focused in the waters off Southern California within the U.S. Navy's Southern California (SOCAL) Range Complex, and primarily near the vicinity of San Clemente Island (SCI). Subsequently, this EA addresses only this initial research location. It is anticipated that additional locations would be added through a major amendment to the permit once sufficient planning details become known.

The SOCAL Range Complex encompasses 120,000 square nautical miles (nm²) of ocean between Dana Point and San Diego, California, and extends southwest from southern California in an approximately 700 by 200 nm rectangle with the seaward corners at 33°30' N. lat.; 127°10' W. long.; 28°30' N. lat.; and 116°00' W. long. See Figure 1-1.

The proposed research activities would leverage instrumentation found on the U.S. Navy underwater tracking ranges within the SOCAL Range Complex and in the vicinity of SCI. These tracking ranges include the deepwater Southern California ASW Range (SOAR) that is located offshore to the west of San Clemente Island (SCI) and the San Clemente Island Underwater Range (SCIUR) located northeast of SCI. These underwater tracking ranges are controlled by the Southern California Offshore Range (SCORE) integrated training facility, which is under the command of the Fleet Area Control and Surveillance Facility, San Diego (FACSFACSD). All SCORE operations are monitored, controlled, and evaluated by Range Operations Center (ROC) personnel at Naval Air Station (NAS) North Island, CA.

The environment affected by the proposed action is described in detail in the Navy SOCAL Range Complex FEIS (DON, 2008), which is publicly available at the NMFS website (see http://www.nmfs.noaa.gov/pr/pdfs/permits/socal_eis_voll.pdf). This information is incorporated herein by reference. Summarized information is included in this document.

3.1 Social and Economic

This section addresses the social and economic environment including commercial shipping, commercial fishing, as well as tourism and recreational activities including whale watching, diving, sport fishing, boating, and surfing. It also includes a discussion of the military support facilities available on SCI given the importance of access to the instrumented underwater tracking ranges off San Clemente Island (SCI) to the proposed research.

3.1.1 Commercial Shipping

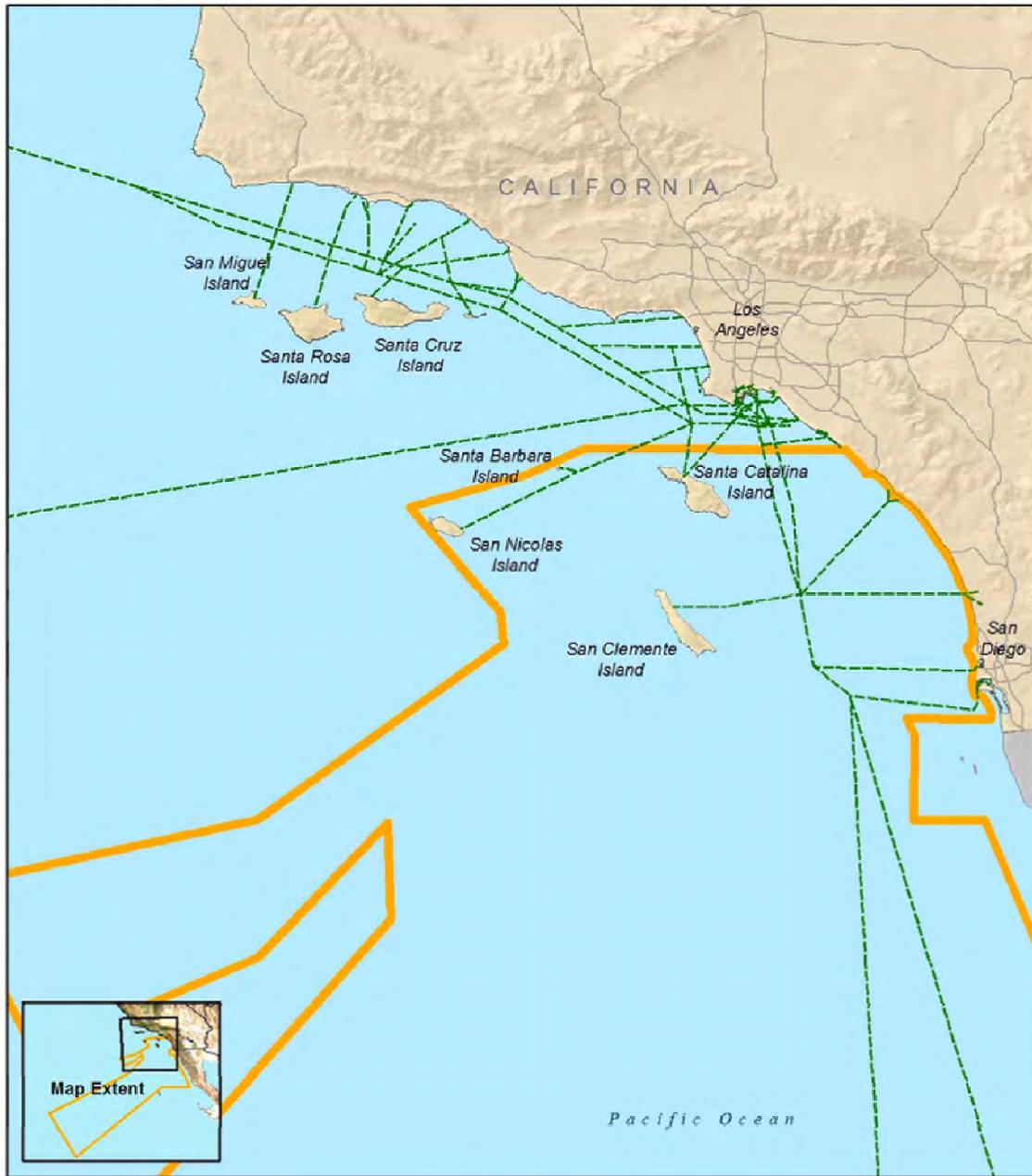
Ocean shipping is a significant component in the Southern California regional economy. Key ports in Southern California include Los Angeles, Long Beach, and, to a lesser degree, San Diego. Los Angeles and Long Beach were ranked first and second among U.S. ports with respect to total cargo imported and exported in 2005; San Diego was ranked 28th (Department of Transportation [DOT] 2007).

For commercial vessels, the major transoceanic routes to the southwest pass north and south of San Clemente Island (SCI). See Figure 3-1. Ships traveling between Los Angeles/Long Beach and Hawaii via the most direct route would pass to the north of the SOCAL Range Complex. Most vessels entering or leaving the ports of Los Angeles or Long Beach travel northwest or south and bypass SCI without incident or delay. Vessels coming or going from the Port of San Diego generally travel along shipping routes near the coast that includes inshore waters of the SOCAL Range Complex but bypass SCI to the east.

3.1.2 Commercial Fishing

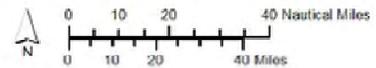
Commercial fishing takes place throughout the SOCAL Range Complex from nearshore waters adjacent to the mainland and offshore islands, to the offshore banks (e.g., Tanner and Cortes Banks), and waters in between. The California Department of Fish and Game (CDFG) maintains commercial catch block data for waters in the northern part of the study area. For the period 2002 to 2005, the most commonly harvested commercial species in the SOCAL operational areas (OPAREAs) were squid, tuna (albacore, yellowfin, bluefin, skipjack, and other), swordfish, Pacific/Jack mackerel, and Pacific sardine.

The local commercial fishing industry makes a significant contribution to the economy. During 2005, the SOCAL OPAREAs accounted for 26.8 percent of all California fish landings and 46.3 percent of invertebrate landings. Pelagic species encompass the majority of the commercial portion of the average annual pounds (lb) of catch. The average annual catch of pelagic, flatfish, demersal, and all other fish amounts to 50,901,141 average annual catch (in lb) and \$6,870,514 (in dollar value). The average annual catch of crustaceans is about half lobster (average 431,805 lb per year) and half crab and shrimp (average 317,735 lb per year). The catch of crustaceans in the SOCAL OPAREAs was worth approximately \$4,314,628 per year. In comparison, the annual catch of squid was worth approximately \$7,186,356 and urchins were worth about \$1,860,552 whereas other invertebrates (e.g., snails, sea cucumbers) were worth about \$210,634 per year.



The project study area does not include Santa Barbara or Santa Catalina Islands; the Navy does not conduct and is not proposing military activities on these islands. The project study area does not include San Nicolas Island; the Navy activities conducted on San Nicolas Island are addressed in the Point Mugu Sea Range EIS/OEIS.

- Approximate Shipping Route
- SOCAL Range Complex (EIS/OEIS Study Area)



Sources: National Waterway Network
US Army Corps of Engineers, ESRI

Figure 3-1: SOCAL Range Complex Shipping Routes (DON, 2008)

3.1.3 Recreation and Tourism

The SOCAL Range Complex marine environments are popular locations for recreational activities accessed by charter or privately operated boats. These activities include whale watching, diving, sport fishing, boating, and surfing. Most recreation- and tourism-related activities occur close to the mainland coast of Southern California or between the mainland and the Channel Islands. Salt-water sport fishing, surfing, and recreational diving are centered primarily around SCI itself, and secondarily in the shallower waters over the Tanner and Cortes Banks. There is very little recreational activity in the southwestern portion of the SOCAL Range Complex due to its distance from land and its water depth.

Whale watching takes place primarily from December through March, for the annual gray whale southward migration and the northward migration. Though tourist day trips typically stay closer to the mainland, these activities can occur throughout the SOCAL Range Complex.

Diving occurs year-round, though the number of trips to SCI and the banks appear to peak during lobster season (October-March). SCI's relatively warm waters, good underwater visibility, and largely pristine diving conditions make it a popular destination. Charter dive trips to specific sites are often published and booked as many as 6 months in advance. Most dive charters are scheduled for weekends, though not all. Due to distance from shore, Tanner and Cortes Banks are inherently more hazardous due to their open-ocean diving conditions. This makes them suitable primarily for skilled divers, a more limited market for charter operators.

Fishing destinations are generally more fluid, in response to changing fishing conditions, but a number of charter boats fish SOCAL Range Complex waters on a routine basis. Sport fishermen pursue various fish species with hook and line; some divers also spearfish or take invertebrates (mainly lobster) by hand within the SOCAL OPAREAs.

Surfing can also be found in the offshore OPAREAs and nearshore SCI areas. In the winter months, when large Northern Pacific ocean swell is generated, some charter and private vessels travel out to Cortes Bank to surf the waves created by the rapidly rising seamounts. Also, surfers can venture year-round to the breaks off of SCI to surf the island's south points (China and Pyramid Points) and up the west shore of the island depending on the swell direction of the season. Although both areas within the SOCAL OPAREAs are accessed throughout the year, due to the difficulty in access and a rare culmination of conditions necessary for surfing these spots, these areas are rarely accessed.

Other limited surf spots and dive sites occur throughout the nearshore areas, for diving, at various shipwrecks and reefs and, for surfing, off of Point Loma and around Santa Catalina Island.

3.1.4 San Clemente Island Military Support Facilities

Military support facilities on SCI are staffed by government contractors, Navy civilian, or active duty Navy military personnel. The mission of SCI and its personnel is to operate facilities and provide services, arms, and material support to Fleet tactical training and Research, Development, Test and Evaluation (RDT&E) activities. All employment on SCI is directly or indirectly related to Navy activities. All activities onshore at SCI are military in nature; therefore, no public recreation or tourism exists on SCI. Some recreation and tourism activities can occur near SCI but not on the island itself.

No permanent resident population exists on SCI. Most of the on-island living quarters are located in the Wilson Cove area, and range from trailers to permanent Bachelor Enlisted Quarters (BEQs). Visitor facilities are limited to 20 individuals. No children live on SCI. Military support facilities are staffed by civilian and Navy personnel on temporary assignments who are not recorded as residents during census counts. While the number of personnel on SCI varies based on mission needs, the constant population is approximately 500 (consisting of Navy personnel, civil service employees, and contractors). During major training exercises, the on-island number of personnel can exceed 1,000 or more for short periods. The primary socioeconomic impact of this workforce is on San Diego County, where most of these personnel have their residences.

The proposed research activities would leverage instrumentation found on the U.S. Navy underwater tracking ranges in the vicinity of SCI. These tracking ranges include the deepwater Southern California ASW Range (SOAR) that is located offshore to the west of San Clemente Island (SCI) and the San Clemente Island Underwater Range (SCIUR) located northeast of SCI.

SOAR, Figure 3-2, has an existing fixed passive acoustic array mounted on the bottom of San Nicholas basin and covers 670 square nautical miles. The system was originally designed to record underwater sounds and provide three-dimensional underwater tracking capability for Navy training events. The current SOAR sensors consist of 88 acoustic sensors (hydrophones) located on the seafloor. These sensors have a bandwidth of 8 – 50 kHz and are being used to detect odontocetes (toothed whales) vocalizing within the range area. Planned updates and refurbishment of this passive array scheduled for summer 2009 would increase the number of hydrophones from 88 to 177 and increase the hydrophone bandwidth to ~50 Hz – 40 kHz. The additional low-frequency bandwidth may be capable of also detecting mysticetes (baleen whales) and pinnipeds (seals and sea lions) (Moretti *et al*, 2008).

The smaller San Clemente Island Underwater Range (SCIUR) covers 25 square nautical miles area to the northeast of SCI. This range is used by the Navy for ASW training and RDT&E of undersea systems. This range contains six passive hydrophone arrays mounted on the seafloor.

Passive acoustic monitoring has the potential to significantly improve the ability to detect marine mammal presence within SCORE. The N45/ONR sponsored Marine Mammal Monitoring on Navy Ranges (M3R) program has developed hardware and software that

leverages the SOAR sensors to detect and localize marine mammal vocalizations. Localization is possible when the same signal is detected, precisely time-tagged, and associated on at least three sensors (Moretti *et al*, 2002). A prototype M3R system has been installed on the SCORE range.

The M3R system is capable of monitoring all the range hydrophones in real-time. The system provides tools to display detected transient signals including marine mammal vocalizations and localizations. The tools operate in real-time and are being used in a series of tests to document marine mammal species, their vocalizations, and their distribution on the SOAR range. A similar M3R system was used to collect and analyze both opportunistic and Behavioral Response Study (BRS) data at the US Navy AUTECH Range in 2007 and 2008.

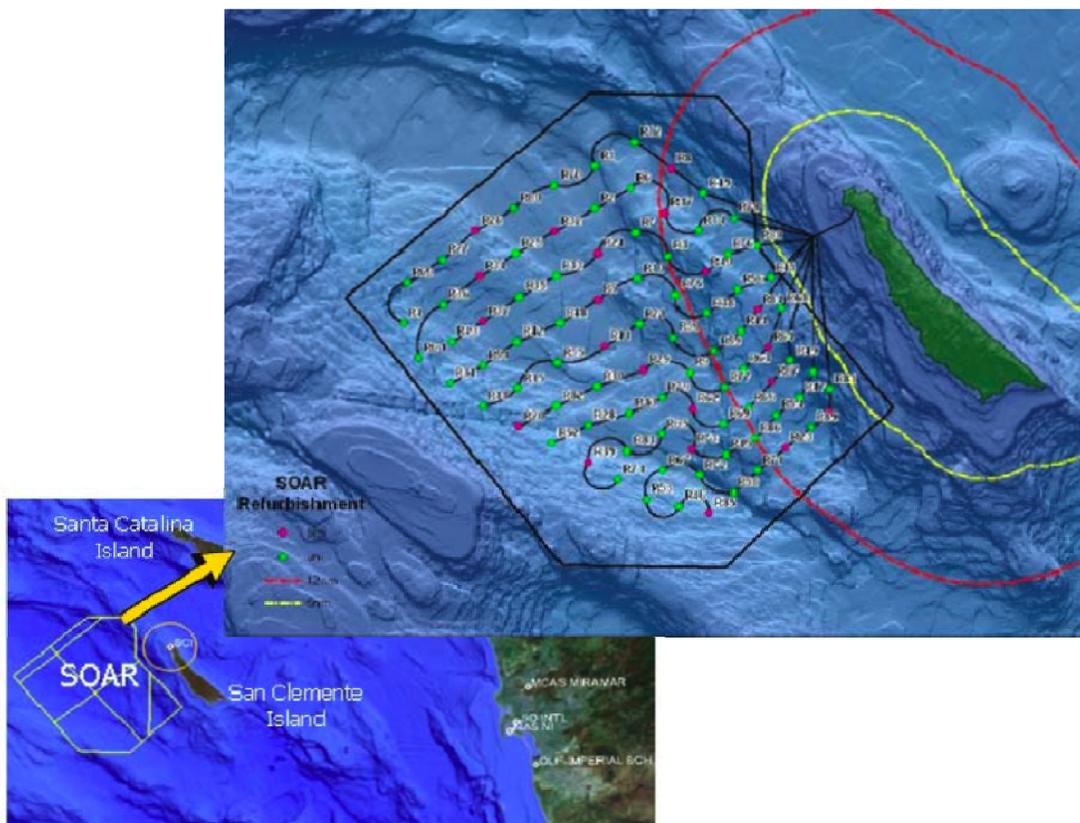


Figure 3-2: Southern California Anti-Submarine Warfare Range (SOAR) and associated underwater tracking hydrophones. (DON, 2008)

3.2 Physical Environment

This section addresses the physical environment including bottom topography, currents and circulation, as well as other environmental characteristics. Primary emphasis is on the area in the vicinity of San Clemente Island (SCI). It also includes discussions on areas near or within the SOCAL Range Complex designated as Marine Protected Areas, Marine Managed Areas, National Sanctuaries, Essential Fish Habitats, and Designated Critical Habitats.

3.2.1 Bottom Topography

The shape of California's coastline south of Point Conception creates a broad ocean embayment known as the Southern California Bight (SCB). The SCB encompasses the area from Point Conception south into Mexico, including the Channel Islands. Bottom topography in the SCB varies from broad expanses of continental shelf to deep basins. Southwest of the Channel Islands lies the Patton Escarpment, a steep ridge with contours bearing in a northwesterly direction. This ridge drops approximately 4,900 feet (ft) (1,500 m) to the deep ocean floor. Between the Patton Escarpment and the mainland lie the Santa Rosa-Cortes Ridge, deep shelf basins (e.g., Catalina, San Clemente, East Cortes, West Cortes, San Nicolas, Tanner); two important channels (Santa Barbara and San Pedro); and a series of escarpments, canyons, banks, and sea mounts (e.g., Cortes Bank, Tanner Bank, 60-Mile Bank, Farnsworth Bank, and Lausen Sea Mount), some of which are located outside of the Range Complex (Figure 3-3).

The ocean floor in the vicinity of San Clemente Island (SCI) includes the Catalina, San Nicolas, East Cortes, and West Cortes Basins. SCI and the Tanner and Cortes Banks are the highest peaks of undersea ridges. The bathymetry surrounding SCI is irregular in shape, with Catalina Basin to the east and San Nicolas Basin to the west. A narrow island shelf extending to a depth of about 330 ft (100 m) surrounds SCI, extending from 0.3 to 3 nm (0.5 to 5.5 km) from the island's coast. Offshore relief east of SCI is extreme due to San Clemente Escarpment, leveling off at a depth of about 3,280 ft (1,000 m) below Mean Sea Level (MSL) in Catalina Basin. Offshore relief south and west of SCI is more gradual, though depths reach a maximum of about 5,900 ft (1,800 m) in San Nicolas Basin.

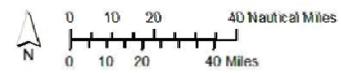
Banks and seamounts possess unique physical characteristics that affect local biological processes. They are the focus of upwellings that attract pelagic fishes and their predators (e.g., seabirds and marine mammals) (Cross and Allen 1993). The Tanner and Cortes Banks are located approximately 97 nm (186 km) and 92 nm (179 km) due west of San Diego, California, respectively. These banks are subsea pinnacles on the Santa Rosa-Cortes Ridge that extend through the SCB in a southeasterly direction from near San Miguel Island to offshore of SCI. Tanner Bank's shallowest depth is approximately 66 ft (20 m); Cortes Bank rises to within 13 ft (4 m) of the ocean surface. Cortes Bank is 15 nm (28 km) south of Tanner Bank, and has approximately four times as much area above the 200-ft (60-m) depth contour. The saddle between the two banks has a depth of 820 ft (250 m), with the sides of the banks sloping at 6 percent or greater (BLM 1978).

SCI is the southernmost of the Channel Islands, and is located in the pathway of the warm, northerly flowing California Counter-Current. SCI is oblong and oriented from northwest to southeast. The leeward (mainland) side of SCI is relatively free from substantial wave and swell disturbance. However, periodic storms produce waves of sufficient magnitude to reposition many of the free rocks and therefore disturb the substrate configuration. Nearshore local currents are driven by wind and tides.



Major Geologic Features

- Bank
- Ocean Basin
- ▼ Canyon
- SOCAL EIS/OEIS Study Area
- ▲ Seamount
- 100m Isobath
- Escarpment



Sources: MCB (2003), NOAA (2002), and Sandwell et al. (2004), NGA, ESRI, Map adapted from: Shepard and Emery (1941) and Emery (1960)

Figure 3-3: Major Geologic Features in the NE portion of the SOCAL Range Complex. (DON, 2008)

The bottom substrate is heavily influenced by local subsurface and oceanographic attributes (DON 1999). Sandy substrates are found predominantly on the continental shelf, while silts (<62 microns (μm) in diameter) and mud are found in basins and on slopes (DON 1999; DON 2000). Nearshore sediment distribution is consistent due to suspended sediment resuspension and mixing by the California Current. Beyond 30 km, there is an increasing percentage of organic carbon and carbonate in the sediment bed with distance from the coast (Lund *et al.* 1992). At the continental shelf break, offshore banks, the shelf around offshore islands (e.g., Santa Catalina and San Clemente Islands), and submarine canyons (Allen *et al.* 1992) rocky substrate dominates. Santa Barbara, Santa Catalina, and San Clemente Islands are typically characterized by high relief rocky habitat surrounded by soft sandy bottoms.

3.2.2 Oceanic Currents and Circulation

The SCB is influenced by two major oceanic currents: the southward-flowing, cold-water California Current and the northward flowing, warm-water California Counter-Current. These currents mix in the SCB, and strongly influence patterns of ocean water circulation, temperature, and water quality along the Southern California coast and around the eight Channel Islands.

The southern portion of the SCB is at the transition between two distinct biogeographic coastal provinces: the Oregonian and the Californian. The cold, temperate waters of the California Current flow from northwest to southeast to meet the warmer waters of the northwesterly flowing California countercurrent just south of Point Conception. When the California Current reaches Point Conception, it flows away from the shoreline, creating a counter-clockwise gyre, the Southern California Eddy, in the SCB. The return flow of this gyre moves to the northeast and north through the southern Channel Islands toward the mainland, before turning toward the northwest. The mixing of cold and warm water masses affects the distribution of marine fauna and flora, leading to the presence of both cold and warm temperature species that thrive in the transition zone and overlap in their distributions.

The coastal headlands, promontories, submarine canyons, basins, ranges, and ridges of the SCB impose variations on the circulation patterns described above, primarily eddies. Northwesterly onshore winds create a southerly alongshore current near the coast, reversing the northward flow of the Southern California Eddy. The resulting circulation pattern differs substantially from other locations along the western coast of the United States. This complex circulation pattern is an important element of the coastal marine ecosystem.

3.2.3 Other Environmental Characteristics

Sea surface temperatures are affected by atmospheric conditions, and can show seasonal variation in association with upwelling, climatic conditions, and latitude (Tait 1980). Surface temperatures of waters along the coast of Southern California range from approximately 54 degrees Fahrenheit ($^{\circ}\text{F}$) (12 degrees Celsius [$^{\circ}\text{C}$]) in winter to 70 $^{\circ}\text{F}$

(21°C) in summer. The coldest sea surface temperatures typically occur in February, while the warmest temperatures typically occur in September (Engle 1994).

Surface waters are usually saturated or supersaturated with dissolved oxygen as a result of photosynthetic activity and wave mixing. Dissolved oxygen levels at the surface fluctuate between 5.4 and 5.9 milliliters per liter (mL/L) (over 100 percent oxygen saturation), while levels at depths below the surface remain more constant between 0.4 and 0.6 mL/L (CALCOFI 1982). Anaerobic conditions are found at the water-sediment interface in many of the deep basins (Dailey *et al.* 1993).

Nutrients are chemicals or elements necessary to produce organic matter. Basic nutrients include dissolved nitrogen, phosphates, and silicates. Dissolved inorganic nitrogen occurs in ocean water as nitrates, nitrites, and ammonia, with nitrates as the dominant form. The nitrate concentration of water in the nearshore California Current varies annually from 0.1 to 10.0 micrograms per liter ($\mu\text{g/L}$). The lowest concentrations typically occur in summer. At a depth of 33 ft (10 m) concentrations of phosphate and silicate in the California Current typically range from 0.25 to 1.25 $\mu\text{g/L}$ and 2 to 15 $\mu\text{g/L}$, respectively (CALCOFI 1982).

The climate of Southern California is characterized by warm, dry summers and mild, wet winters. One of the main determinants of the climatology is a semi-permanent high-pressure area (the Pacific High) in the eastern Pacific Ocean. In the summer, this pressure center is located well to the north, causing storm tracks to be directed north of California. This high-pressure cell maintains clear skies in Southern California for much of the year. When the Pacific High moves southward during the winter, this pattern changes, and low-pressure centers migrate into the region, causing widespread precipitation. The Pacific High also influences the wind patterns of California. The predominant wind directions are westerly and west-southwesterly during all four seasons, and the average annual wind speed is 5.6 mi./hour (hr.) (8.2 meters (m)/second [sec.]).

Long-term climatic influences in the region include El Nino-Southern Oscillation (commonly referred to simply as El Nino), Pacific Decadal Oscillation, and global warming. The recurring El Nino pattern is one of the strongest in the ocean-atmosphere system. El Nino is defined by relaxation of the trade winds in the central and western Pacific, which can set off a chain reaction of oceanographic changes in the eastern Pacific Ocean. Off the coast of California, El Nino events are characterized by increases in ocean temperature and sea level, enhanced onshore and northward flow, and reduced coastal upwelling of deep, cold, nutrient-rich water. During this period, plankton abundance decreases, resulting in a decrease in survivorship and reproductive success of planktivorous invertebrates and fishes. Marine mammals and seabirds, which feed on these organisms, experience widespread starvation and decreased reproductive success.

Every 20 to 30 years, the surface waters of the central and northern Pacific Ocean (20 degrees north [$^{\circ}\text{N}$] and poleward) shift several degrees from their mean temperature. Such shifts in mean surface water temperature, known as the Pacific Decadal Oscillation, have been detected five times during the past century, with the most recent shift having

occurred in 1998. This oscillation affects production in the eastern Pacific Ocean and, consequently, affects organism abundance and distribution throughout the food chain.

Ocean waters off the coast of California have warmed considerably over the last 40 years. It is not clear if this warming is a consequence of an interdecadal climate shift, or global warming. In response to this phenomenon, along with the two discussed above, some marine species have shifted their geographic ranges northward, altering the composition of local assemblages of biota (National Centers for Coastal Ocean Science 2005).

Sources of ambient oceanic noise include wind, distant shipping, rain, oceanic turbulence, marine animals, tides, waves, volcanic eruptions, seismic activity, and industrial activities. The ambient noise frequency spectrum can be predicted fairly accurately for most deep-water areas based primarily on known shipping traffic density and wind state (wind speed, Beaufort wind force, or sea state) (Urick 1983). D'Spain and Batchelor (2006) reported the source spectral density in waters deeper than 246 ft. within the Southern California Bight is 105 to 120 dB re $1 \mu\text{Pa}^2/\text{Hz}@1\text{m}$. (centered around 1.5 kHz and between 4 and 5 kHz). In contrast to deep water, ambient noise levels in shallow waters (i.e., coastal areas, bays, harbors, etc.) are subject to wide variations in level and frequency depending on time and location. Noise levels at any given location are determined not only by the acoustic power output of the contributing sources (a function of the SL and frequency) but also by local acoustic propagation conditions. Sound propagation is affected by several variables, including water depth, temperature profile, salinity, bottom slope, and type of bottom. Where the bottom is reflective, the noise levels tend to be higher in comparison to regions where the bottom is absorptive. The quietest ambient noise levels anticipated for the region of the proposed study ranges from approximately 40 to 80 dB re $1 \mu\text{Pa}^2/\text{Hz}@1\text{m}$ depending on winds, weather, and distant shipping among other factors.

3.2.4 Marine Protected Areas and Marine Managed Areas

Marine Protected Areas (MPAs), as defined in EO 13158, are “any area of the marine environment that has been reserved by Federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein.” Section 5 of EO 13158 stipulates, “each Federal agency whose actions affect the natural or cultural resources that are protected by MPAs shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each Federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA.”

Many areas of U.S. marine waters receive some level of managed protection. Marine Managed Areas (MMAs) are similar to MPAs in that they have a conservation or management purpose, defined boundaries, and some legal authority to protect resources. MMAs encompass a wider range of management intents, which include areas of protection for geological, cultural, or recreational resources that might not be included under the definition provided in EO 13158 for MPAs. MMAs may also include areas that are managed for reasons other than conservation (e.g., security zones, shellfish closures, sewage discharge areas, and pipeline and cable corridors). Of the current 251 Federal

sites in the MMA Inventory, many are located within the boundaries of the SOCAL Range Complex (NOAA 2009a). Figure 3-4 depicts the MMAs in and around SOCAL.

The boundaries of the Channel Islands National Marine Sanctuary (CINMS) extend from mean high tide to 6 nautical miles (nm) offshore, with California state waters extending 3 nm from the shores off San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara Islands (NOAA 2009b). NOAA designated this National Marine Sanctuary (NMS) in 1980 and set aside 1,252 square nautical miles (nm²) of protected area in this sanctuary. Santa Barbara Island is the only CINMS island that is located within the boundaries of the SOCAL Range Complex. Within these boundaries there are several regulatory agencies (i.e., Federal, state, and local) that have overlapping jurisdiction.

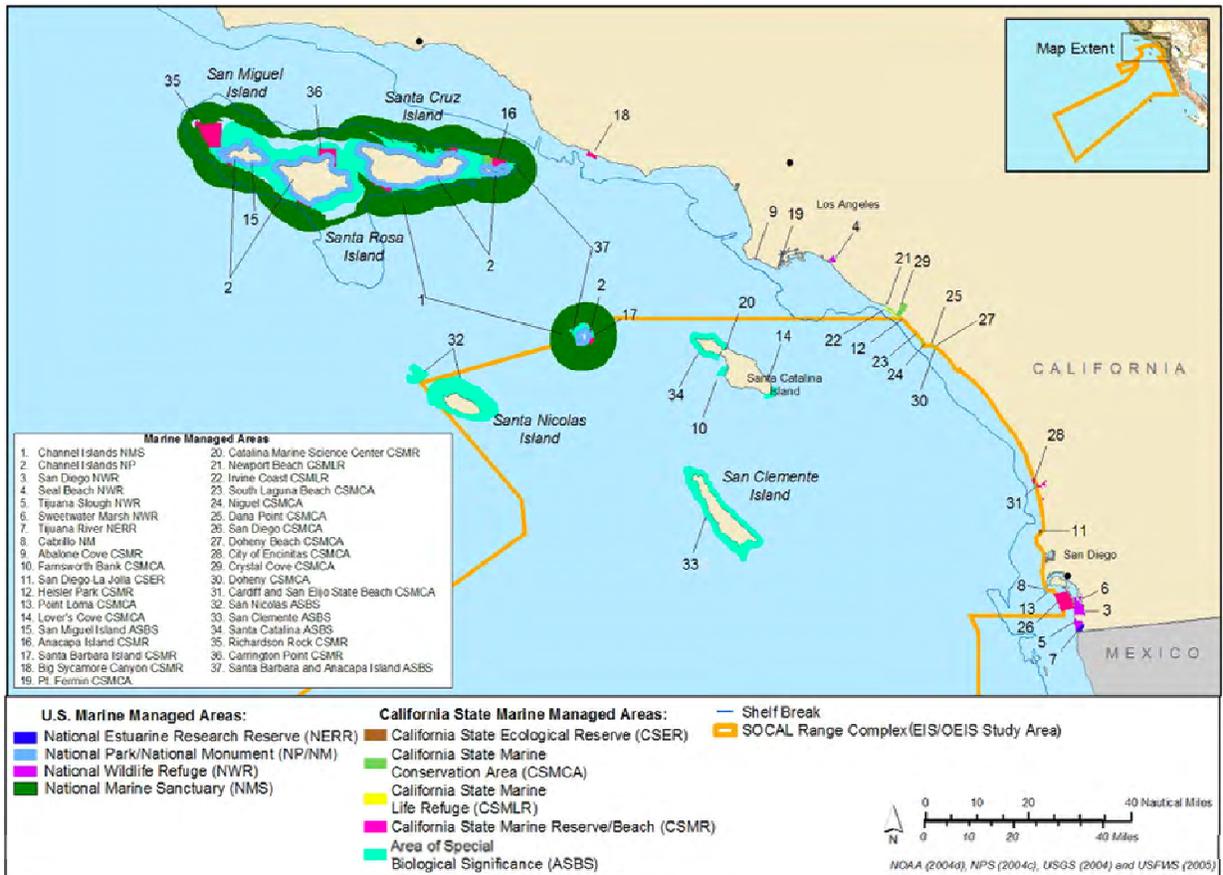


Figure 3-4: Locations of U.S. Federal Managed Marine Areas and California State MMAs in SOCAL and vicinity

3.2.5 Essential Fish Habitat

Congress defined Essential Fish Habitat (EFH) as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 U.S.C. 1802(10)).

The EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act offer resource managers means to accomplish the goal of giving heightened consideration to fish habitat in resource management. EFH has been designated for many of the fish species within the action area. Details of the designations and descriptions of the habitats are available in the Pacific Fishery Management Plans.

NMFS and the Fishery Management Council have developed Fishery Management Plans (FMPs) to manage the fishery and address fish habitat issues, specifically the principle that there would be no net loss of the productive capacity of habitats that sustain commercial, recreational, and native fisheries. The SOCAL Range Complex contains EFH for 109 species covered under three FMPs. These 109 managed species include 83 species of groundfish that live on or near the bottom (e.g., rockfish and flatfish), six pelagic species that live in the water column (e.g., anchovies, mackerel, and squid), and 13 highly migratory species including tuna, billfish, and sharks.

Activities that have been shown to affect EFH include disturbance or destruction of habitat from stationary fishing gear, dredging and filling, agricultural and urban runoff, direct discharge, and the introduction of exotic species. None of the activities in the Proposed Action are directed at or likely to have any impact on any designated EFH.

3.2.6 Designated Critical Habitat

No critical habitat has been designated for any endangered whale species other than right whales. Right whale critical habitat has only been designated in the Atlantic Ocean, which is not within the action area for the proposed action. Critical habitat has been designated for leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles in the Atlantic, but not in the Pacific; thus there is no sea turtle critical habitat within the range of the proposed research. Critical habitat has been designated for Central California Coast Coho salmon (*Oncorhynchus kisutch*) (50 CFR §226.210) and for a number of evolutionary significant units of salmon and steelhead (50 §CFR 226.212); however, it is all located well north of the action area.

3.3 Biological Environment

A wide variety of marine species could be found within the action area, including marine mammals, sea turtles, invertebrates, fish, and sea birds. Since merely being present within the action area does not necessarily mean a marine organism would be affected by the proposed action, the following discussion focuses not only the distribution and abundance (or density) of various species that may be present at the time of the proposed study, but also on whether or not the sounds produced during the behavioral response studies would be within the hearing range of that organism.

3.3.1 Invertebrates

A variety of invertebrates may be present within the action area including assorted mollusks, crustaceans, sponges, and jellyfish. These invertebrates are described in Chapter 3.6 of the SOCAL Range Complex FEIS (DON 2008), which is incorporated

herein by reference. The white abalone (*Haliotis sorenseni*) is the only federally listed endangered marine invertebrate animal that may occur within the SOCAL Range Complex. The white abalone, historically found from Punta Abreojos, Baja California, Mexico, to Point Conception, California, is a mollusk that occurs on hard substrate, reportedly in water depths of 65 to 196 ft (20 to 60 m) (NMFS 2001, 2006).

Very little is known about sound detection and use of sound by invertebrates (see Budelmann 1992a, b, Popper *et al.* 2001 for reviews). The limited data shows that some crabs are able to detect sound, and there has been the suggestion that some other groups of invertebrates are also able to detect sounds. In addition, cephalopods (octopus and squid) and decapods (lobster, shrimp, and crab) are thought to sense low-frequency sound (Budelmann 1992b). Packard *et al.* (1990) reported sensitivity to sound vibrations between 1 and 100 hertz (Hz) for three species of cephalopods. Lovell *et al.* (2005) concluded that at least one species from the invertebrate sub-phylum of crustacean (*Palaemon serratus*), is sensitive to the motion of water particles displaced by low-frequency sounds ranging from 100 Hz up to 3000 Hz. Few invertebrates have tissues with acoustic impedance sufficiently different from seawater to pose a risk of non-auditory damage (*i.e.*, from resonance). Therefore there is likely to be little risk of either auditory or non-auditory physical damage. Given the relatively short duration of time over which sounds for the BRS would be broadcast, the proposed study would contribute a negligible amount to the acoustic environment of these animals.

3.3.2 Fish

The southern portion of the Southern California Bight (SCB) is a transitional zone between subarctic and subtropical water masses. The California Current system is rich in microscopic organisms (*i.e.*, diatoms, tintinnids, and dinoflagellates), which form the base of the food chain in the SOCAL Range Complex. Small coastal pelagic fishes and squid depend on this planktonic food supply and in turn are fed upon by larger species (*e.g.*, highly migratory species [HMS]). Of the 519 recognized California marine fish species, there are at least 481 species within the greater SCB, south of Point Conception (Horn 1980, Cross and Allen 1993, Horn *et al.* 2006). Occasional climatic level shifts in ocean mass resulting from El Niño, and La Niño events can directly influence the either warm- or cold-water species composition during any given year. Chapter 3.7 of the SOCAL Range Complex FEIS (DON 2008) provides an extensive discussion of the species present.

The SOCAL Range Complex contains Essential Fish Habitats (EFH) for 109 species covered under three FMPs. These 109 managed species include 83 species of groundfish that live on or near the bottom (*e.g.*, rockfish and flatfish), six pelagic species that live in the water column (*e.g.*, anchovies, mackerel, and squid), and 13 highly migratory species including tuna, billfish, and sharks. NMFS and the Fishery Management Council have developed Fishery Management Plans (FMPs) to manage the fishery and address fish habitat issues, specifically the principle that there would be no net loss of the productive capacity of habitats that sustain commercial, recreational, and native fisheries.

There are three endangered species and one threatened species of fish that might possibly

be found in the SOCAL Range Complex waters. The endangered species include Steelhead (*Oncorhynchus mykiss*), tidewater goby (*Eucyclogobius newberryi*), and chinook salmon (*Oncorhynchus tshawytscha*). The threatened species is the green sturgeon (*Acipenser medirostris*). Very little life history information is available for the Southern California Evolutionary Significant Unit (ESU) of steelheads (NMFS 1997). There is high variability in life history for this species, in terms of when and if adults become anadromous and utilize the marine environment, because of Southern California's variable seasonal and annual climatic conditions. Tidewater gobies are uniquely adapted to coastal lagoons and the uppermost brackish zone of larger estuaries, rarely invading marine or freshwater habitats. They are not expected to be found in the marine habitats where the proposed research would be conducted. Although anecdotal information suggests that the Chinook salmon and green sturgeon may be found in the SCB, given the lack of observations or incidences of bycatch in Southern California fisheries, they are likely rare visitors to the area.

Fish, like other vertebrates, have a variety of different sensory systems that enable them to glean information from the world around them (see volumes by Atema *et al.* 1988 and by Collin and Marshall 2003 for thorough reviews of fish sensory systems). Fishes have evolved two sensory systems to specifically detect acoustic signals, and many species use sound for communication (e.g., mating, territorial behavior – see Zelick *et al.* 1999 for review). The two systems are the ear, for detection of sound above perhaps 20 hertz (Hz) to 1 kilohertz (kHz) or more, and the lateral line for detection of hydrodynamic signals (water motion) from less than 1 Hz to perhaps 100 or 200 Hz. The inner ear in fish functions very much like the ear found in all other vertebrates, including mammals. The lateral line, in contrast, is only found in fish and a few amphibian (frogs) species. It consists of a series of receptors along the body of the fish. Together, the ear and lateral line are often referred to as the octavolateralis system.

Hearing thresholds have been determined for perhaps 100 of the more than 29,000 living fish species (see Fay 1988, Popper *et al.* 2003, Ladich and Popper 2004, Nedwell *et al.* 2004 for data on hearing thresholds). These studies show that, with few exceptions, fish cannot hear sounds above about 3-4 kHz, and that the majority of species are only able to detect sounds to 1 kHz or even below. Myrberg (1980) states that the most important region of sound detection in most fishes rests between about 40 and 1000 Hz.

Fish that have specializations to enhance their hearing sensitivity have been referred to as hearing specialists, whereas those that do not possess such capabilities are termed generalists. The former tend to have greater sensitivity and a wider hearing bandwidth (up to 3 kHz) than the latter. The mid-frequency sound transmissions in the proposed research are typically higher in frequency than that which the majority of generalist species can detect. Thus, the proposed research may not elicit any response from most fish species. However, even if fish were to show responses to the proposed sound transmissions, the observed responses occurred at intense (high) received levels, which in the proposed research would only occur over a very small range close to the sound source. Furthermore, ramp up procedures for the sound sources should allow fish that can hear and are disturbed by the sounds to move away from the sound source. As with

invertebrates, the proposed study would contribute a negligible amount to the acoustic environment of fish due to the relatively small area in which the sounds might even be detectable and the short duration of time over which sounds would be broadcast.

Some fish have swimbladders, which present a tissue boundary that may be affected by underwater sound, so these species are potential candidates for non-auditory acoustic damage. Resonance scattering by swimbladder-bearing fish is typically in the 1-10 kHz frequency region. This scattering effect is routinely exploited for acoustic fish detection by conventional high-frequency echosounders, and more recently through the use of low to mid-frequency acoustic systems (Ratilal *et al.*, 2007; Pecknold *et al.*, 2008). Since the acoustic impedance of air and water are very different, there is a potential for tissues at the boundary of these two impedances to become stressed and rupture. However, while the frequencies of interest in the proposed research are within the frequency ranges at which fish swimbladders have demonstrated resonance, the proposed source level is below that required to set up resonance effects that may pose a risk of swimbladder damage. Furthermore, ramp up procedures for the sound sources should allow fish that are disturbed by the sounds to move away from the sound source. Thus, the proposed action would not have a substantial effect on fish with swimbladders.

3.3.3 Sea Turtles

Four species of sea turtles occur at sea off the coast of Southern California: loggerhead (*Caretta caretta*), eastern Pacific green (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), and leatherback (*Dermochelys coriacea*). None of the four species is known to nest on Southern California beaches. Nesting by olive ridley turtles occurs along the Pacific coast of Baja California Sur, which is the northernmost known nesting site in the eastern north Pacific (Fritts *et al.* 1982; Sarti-M. *et al.* 1996; López-Castro *et al.* 2000). Due to the primarily oceanic distributions of the leatherback, loggerhead, and olive ridley turtles off Southern California, the southwestern portion of the Southern California (SOCAL) Range Complex is designated as an area of primary occurrence for all sea turtle species (DON 2005); although their presence within the SOCAL Range Complex is considered rare. There is also an area of primary occurrence in southern San Diego Bay due to the year-round prevalence of green turtles in those waters near the warm water outflow of a power plant. All are currently listed as either endangered or threatened under the ESA. Chapter 3.8 of the SOCAL Range Complex FEIS (DON 2008) provides an extensive discussion of these sea turtles.

Sea turtles have well-developed ears, but their auditory sensitivity is poor. Several studies suggest that they can hear sounds below 1 kHz, but no evidence suggests that they can hear higher frequencies. Studies of hearing in juvenile loggerhead sea turtles suggest that they can hear frequencies between 250-750 Hz, with best hearing at 250 Hz (Bartol *et al.*, 1999). Green turtles are most sensitive to frequencies of 300-400 Hz, but their sensitivity declines rapidly outside of this range (Ridgway *et al.*, 1969). Ridgway *et al.* (1969) used aerial and mechanical stimulation to measure the cochlear response in three specimens of green sea turtle, and concluded that they have a useful hearing span of perhaps 60-1000 Hz, but hear best from about 200 Hz up to 700 Hz, with their sensitivity falling off considerably below 200 Hz. One turtle with a 400 Hz frequency best hearing

sensitivity showed a hearing threshold of about 64 dB in air (approximately 126 dB in water, if one corrects for the differences in acoustic impedance between air and water and the different ways sounds in air and water are referenced). Lenhardt *et al.* (1983) applied audio frequency vibrations at 250 Hz and 500 Hz to the heads of loggerheads and Kemp's ridleys submerged in salt water. At the maximum upper limit of the vibratory delivery system, the turtles exhibited abrupt movements, slight retraction of the head, and extension of the limbs in the process of swimming. Lenhardt *et al.* (1983) concluded that bone-conducted hearing appears to be a reception mechanism for at least some of the sea turtle species, with the skull and shell acting as receiving surfaces. There are no audiogram data available for leatherbacks. Because they are morphologically distinct, approximating hearing thresholds from data available for the other (hard shell) species is probably inappropriate.

Sea turtles are not likely to be affected by the proposed action in that the acoustic energy from the BRS sound sources is above the hearing frequency range of sea turtles. Even if any were present, it is not likely that these signals could be heard or would have adverse effects on sea turtles.

3.3.4 Seabirds

The Southern California (SOCAL) Range Complex covers a geographic area located in the center of the California current. The abundant food in the California current, resulting from high ocean primary productivity, attracts millions of seabirds that breed and/or migrate throughout the region annually, with nonbreeders outnumbering breeders year-round, two to one (Mills *et al.* 2005). Populations of birds contained within the SOCAL Range Complex are not accurately documented. However, a variety of seabirds are known to occur within the SOCAL Range Complex with the most numerous groups being shearwaters, storm petrels, phalaropes, gulls, terns, and auklets. Several seabird species are considered particularly important here because of their large population numbers, their limited ranges, the rapid decrease in populations, or their use of critical or unique habitats (Dailey *et al.* 1993). Chapter 3.10 of the SOCAL Range Complex FEIS (DON, 2008) provides an extensive discussion of these seabirds.

Of the 48 seabird species known to occur within the SOCAL Range Complex, several are under the listing authority of the Endangered Species Act (ESA). Of the species provided protection under the ESA, three are listed as federally endangered (California brown pelican, California least tern, and short-tailed albatross), one is federally threatened (marble murrelet), and one is a candidate for listing (Xantus's murrelet). Additional seabirds identified as species of concern by the state of California, United States (U.S.) Fish and Wildlife Service (USFWS), and the Audubon Society include several species of tern, auklet, and murrelet, among others. All seabirds occurring within the SOCAL Range Complex are afforded protection under the Migratory Bird Treaty Act (MBTA). The 1988 amendment to the Fish and Wildlife Conservation Act mandated the USFWS to

Table 3-1: Seabirds known to occur in the SOCAL Range Complex

Common Name	Genus species	Status
red-throated loon	<i>Gavia stellata</i>	
arctic loon	<i>Gavia arctica</i>	
common loon	<i>Gavia immer</i>	
short-tailed albatross	<i>Phoebastria albatrus</i>	FE
Laysan albatross	<i>Phoebastria immutabilis</i>	
black-footed albatross	<i>Phoebastria nigripes</i>	BCC
pink-footed shearwater	<i>Puffinus creatopus</i>	
sooty shearwater	<i>Puffinus ariseus</i>	
black-vented shearwater	<i>Puffinus opisthomelas</i>	
leach's storm-petrel	<i>Oceanodroma leucorhoa</i>	
ashy storm-petrel	<i>Oceanodroma homochroa</i>	BCC
black storm-petrel	<i>Oceanodroma melania</i>	
least storm-petrel	<i>Oceanodroma microsoma</i>	
California brown pelican	<i>Pelecanus occidentalis californicus</i>	CE, FE
double-crested cormorant	<i>Phalacrocorax auritus</i>	
Brandt's cormorant	<i>Phalacrocorax penicillatus</i>	
pelagic cormorant	<i>Phalacrocorax pelagicus</i>	
surf scoter	<i>Melanitta perspicillata</i>	
white-winged scoter	<i>Melanitta fusca</i>	
red-necked phalarope	<i>Phalaropus lobatus</i>	
red phalarope	<i>Phalaropus fulicaria</i>	
pomarine jaeger	<i>Stercorarius pomarinus</i>	
parasitic jaeger	<i>Stercorarius parasiticus</i>	
long-tailed jaeger	<i>Stercorarius longicaudus</i>	
Bonaparte's gull	<i>Lanus Philadelphia</i>	
Heermann's gull	<i>Lanus heermanni</i>	
mew gull	<i>Lanus canus</i>	
ring-billed gull	<i>Lanus delawarensis</i>	
California gull	<i>Lanus californicus</i>	
herring gull	<i>Lanus argentatus</i>	
western gull	<i>Lanus occidentalis</i>	
glaucous-winged gull	<i>Lanus glaucescens</i>	
black-legged kittiwake	<i>Rissa tridactyla</i>	
Caspian tern	<i>Sterna caspia</i>	
common tern	<i>Sterna hirundo</i>	
elegant tern	<i>Sterna elegans</i>	BCC
gull-billed tern	<i>Sterna nilotica</i>	BCC
royal tern	<i>Sterna maxima</i>	
arctic tern	<i>Sterna paradisaea</i>	
Forster's tern	<i>Sterna forsteri</i>	
California least tern	<i>Sterna antillarum browni</i>	CE, FE
black skimmer	<i>Rynchops niger</i>	BCC
pigeon guillemot	<i>Cephus columba</i>	
Xantus's murrelet	<i>Synthliboramphus hypoleucus</i>	BCC
Craveri's murrelet	<i>Synthliboramphus craveri</i>	
marbled murrelet	<i>Brachyramphus marmoratus</i>	CE, FT
Cassin's auklet	<i>Ptychoramphus aleuticus</i>	BCC
rhinoceros auklet	<i>Cerorhinca monocerata</i>	

BCC – Bird of Conservation Concern, 2002, **FE** – Federally Endangered, **FT** – Federally Threatened, **CE** – California Endangered
 (Reprinted from DON 2008; Adapted from Dailey et al. 1993 with additions)

“identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973.” These species, subspecies, and populations are called Birds of Conservation Concern.

Seabirds that forage for food at sea by plunging or diving beneath the surface could be exposed to underwater sound. Little is known about hearing in seabirds nor about underwater hearing in any bird species. Dooling (1978) summarizes studies of in-air hearing in birds and notes that behavioral measurements of absolute auditory sensitivity in a wide variety of birds show a region of maximum sensitivity between 1 and 5 kHz, which is within the frequency band of the sound sources for the proposed research. However, even if some diving birds were able to hear the signal, it is unlikely to have a significant impact because: 1) there is no evidence seabirds use underwater sound; 2) seabirds spend a small fraction of time submerged; and 3) seabirds could rapidly fly away from the area and disperse to other areas if disturbed. Once again, as mentioned with invertebrates and fish, the proposed study would contribute a negligible amount to the acoustic environment of sea birds due to the relatively small area in which the sounds might be detectable and given the short duration of time over which sound sources would be broadcast.

3.3.5 Marine Mammals

A broad range of marine mammal species are found in southern California waters and in the SCORE range in particular, including odontocetes, mysticetes, and pinnipeds. Of the 43 marine mammal species or stocks (based on the National Marine Fisheries Service [NMFS] Stock Assessment Reports; Carretta *et al.* 2007) that could be found within the SOCAL Range Complex, there are approximately 18 year-round species, 6 migratory species, and 19 infrequent or rare species, (Dailey *et al.* 1993; Forney and Barlow 1998; Department of the Navy [DoN] 2005; Carretta *et al.* 2007; Barlow and Forney 2007). Extensive natural history information for marine mammal species within Southern California has been summarized in previous works (Leatherwood *et al.* 1982; 1988; DON 2002; Reeves *et al.* 2002; DON 2005; Carretta *et al.* 2007).

Some odontocetes are found in southern California offshore waters throughout the year, whereas others migrate into the area on a seasonal basis. Short-beaked common dolphins (*Delphinus delphis*) are one of the most abundant odontocete species off California, and are present year-round in SCORE. Likewise, an offshore population of bottlenose dolphins (*Tursiops truncatus*) occurs during all seasons throughout the Southern California Bight. Risso's dolphins (*Grampus griseus*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), northern right whale dolphins (*Lissodelphis borealis*), and Dall's porpoise (*Phocoenoides dalli*) exhibit a seasonal presence at SCORE, moving into waters off California during cold-water months (November – April) and shifting northward or offshore in warmer months (May – October). Several additional odontocete species inhabit southern California waters in all seasons or with unknown seasonal patterns. Among these are the sperm whale (*Physeter macrocephalus*), killer whale (*Orcinus orca*), Baird's beaked whale (*Berardius bairdii*), short-finned pilot whale

(*Globicephala macrorhynchus*), false killer whale (*Pseudorca crassidens*), Cuvier's beaked whale (*Ziphius cavirostris*), and various other beaked whale species (*Mesoplodon spp.*).

Mysticetes are seen off southern California in all seasons, though certain species are more numerous during particular seasons. For instance, blue (*Balaenoptera musculus*) and humpback (*Megaptera novaeangliae*) whales may be present in significant numbers in the summer and fall as they migrate through the Southern California Bight. Gray whales migrate southward through the region between November - February and northward in April - June. Minke whales (*B. acutorostrata*), fin whales (*B. physalus*), and sei whales (*B. borealis*) inhabit southern California waters in all seasons.

California sea lions (*Zalophus californianus*) are the most abundant pinniped in the SCORE region, with numbers of animals encountered both at sea and ashore on San Clemente Island. In fewer numbers, harbor seals (*Phoca vitulina*) and northern elephant seals (*Mirounga angustirostris*) are less abundant but are also found hauled out on San Clemente Island and are observed at sea in the SCORE region.

There are 10 marine mammal species listed as endangered under the ESA with confirmed or possible occurrence in the SOCAL Range Complex. Three of these, North Pacific right whale (*Eubalaena japonica*), Steller sea lion (*Eumetopias jubatus*), and killer whale (*Orcinus orca*) Southern Resident Stock are considered to be extralimital and are not expected to be in the SOCAL Range Complex (DON 2005).

The blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*), are expected to regularly occur in the SOCAL Range Complex. The Guadalupe fur seal (*Arctocephalus townsendi*) is a rare, occasional visitor in the SOCAL Range Complex. The range of the southern sea otter (*Enhydra lutris nereis*) currently extends to just north of Point Conception. There is a translocated population at San Nicolas Island. Some sea otters originating from this translocated population have moved south of Point Conception. These and the translocated population are considered an "experimental population" for purposes of application of the ESA (USFWS 2008).

Stocks of all species listed as endangered under the ESA are automatically considered to be "depleted" and "strategic" under the MMPA. The specific definition of a strategic stock is complex, but in general it is a stock for which human activities may be having a deleterious effect on the population and it may not be sustainable. The stocks of blue, fin, sei, and humpback whales occurring off California are considered strategic (Barlow *et al.* 1997). In addition, the California/Oregon/Washington Stock of the short-finned pilot whale (*Globicephala macrorhynchus*) and sperm whale have been designated as strategic (Carreta *et al.* 2004; 2006).

NMFS publishes annual stock assessment reports for the marine mammals under its jurisdiction. Except for southern sea otters, details on the distribution, abundance, productivity and annual human-caused mortality for the species listed in Table 3-2 can be

found in the U.S. Pacific Marine Mammal Stock Assessment reports which are available in PDF from the NMFS website. The most current information on the status of the southern sea otter is available from the U.S. Fish and Wildlife Service, which has jurisdiction for this species.

The estimated take calculations in Chapter 2 rely on having associated densities for each species. After a brief discussion on the densities provided by Table 3-2, information summaries are provided for those species that have regular occurrence in the SOCAL Range Complex.

MARINE MAMMAL DENSITY INFORMATION

The southern California region has been systematically surveyed for several years (1991-1993, 1996, 2001, 2005) by the National Marine Fisheries Service (NMFS), both via aircraft (e.g., Carretta and Forney, 1993) and vessel (e.g., Ferguson and Barlow, 2001; Barlow, 2003; Forney, 2007). One recent vessel survey was conducted in the US Exclusive Economic Zone (EEZ) and out to 300 nm offshore California, Oregon and Washington by NMFS in summer and fall 2005 (Forney, 2007). There has also been regional survey effort in the area, particularly around San Clemente Island and in extreme near shore areas (e.g., Carretta *et al.*, 2000; Carretta, 2003). Consequently there are several density estimates available for most cetacean species in southern California. Compiled densities from vessel surveys conducted since 1986 have been analyzed by Elizabeth Becker (Becker 2007), under contract to NMFS. These density compilations prorate densities of “unidentified” species groups (such as unidentified dolphins, small whales, orquals, large whales, etc) with densities of identified species, so likely represent the most conservative densities at this time for the southern California region. Densities are presented for warm (May-October) and cold water (November-April) seasons in water depths >1000 m north of 30°N. Gray whale densities were taken from Carretta *et al.* (2000), and are applicable for January-April only.

Pinniped at-sea density is not often available because pinniped abundance is obtained via shore counts of animals at known rookeries and haulouts. Therefore, densities of pinnipeds were derived quite differently from those of cetaceans. Several parameters were identified from the literature, including area of stock occurrence, number of animals (which may vary seasonally) and season, and those parameters were then used to calculate density. Determining density in this manner is risky as the parameters used usually contain error (e.g., geographic range is not exactly known and needs to be estimated, abundance estimates usually have large variances) and, as is true of all density estimates, it assumes that animals are always distributed evenly within an area, which is likely never true. However, this remains one of the few means available to determine at-sea density for pinnipeds.

Sea otters occur along the central California coast and there is an experimental population of relocated otters at San Nicolas Island. The San Nicolas Island colony is considered to be a “non-essential experimental” population under the Endangered Species Act.

Additional details regarding density computations may be found in the Navy FEIS for the SOCAL Range Complex (DON 2008).

Table 3-2: Density and Group Size for Marine Mammal Species in Vicinity of Proposed Action

Common Name	Scientific Name	Target or Non-target species	SOCAL Warm Season density/km ²	SOCAL Cold Season density/km ²	Group Size	Assumed Mean Group Size	Source for Group Size
MYSTICETES							
Blue whale	<i>Balaenoptera musculus</i>	Target	0.0041222	0.0041222	1 to 2	2	Barlow, 2003
Fin whale	<i>B. physalus</i>	Target	0.0024267	0.0008008	Often seen swimming alone or in pairs.	3	Barlow, 2003
Sei whale	<i>B. borealis</i>	Non-target	0.0000081	0.000005	Normally found alone or in groups of 2-5 individuals	3	Barlow, 2003
Bryde's whale	<i>B. edeni</i>	Non-target	0.0000081	0.0000081	Swims alone or in pairs	1.5	Barlow, 2003
Minke whale	<i>B. acutorostrata</i>	Non-target	0.0010313	0.0010313	Generally solitary or seen in pairs or threes	1	Moretti <i>et al</i> , 2008*
Humpback whale	<i>Megaptera novaeangliae</i>	Non-target	0.0001613	0.0000984	Most sightings are of single or pairs of animals and rarely exceed 4 or 5	1	Moretti <i>et al</i> , 2008*
Gray whale	<i>Eschrichtius robustus</i>	Target	0	0.051**	Mean group size is 2-3 whales	3	Caretta <i>et al</i> , 2000

Common Name	Scientific Name	Target or Non-target species	SOCAL Warm Season density/km ²	SOCAL Cold Season density/km ²	Group Size	Assumed Mean Group Size	Source for Group Size
ODONTOCETES							
Sperm whale	<i>Physeter macrocephalus</i>	Target	0.0014313	0.0008731	1 to 19	5	Claridge, 2006
Pygmy sperm whale	<i>Kogia breviceps</i>	Non-target	0.0013785	0.0013785	1 to 2	1	Claridge, 2006
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Target	0.0036883	0.0036883	1 to 5	2	Claridge, 2006
Baird's beaked whale	<i>Berardius bairdii</i>	Target	0.0001434	0.0001434	5 to 20	7	Barlow and Forney, 2007
Mesoplodonts [includes Blainville's beaked whale (<i>M. densirostris</i>), Hubb's beaked whale (<i>M. carlhubbsi</i>), Perrin's beaked whale (<i>M. perrini</i>), pygmy beaked whale (<i>M. peruvianus</i>), and ginkgo-toothed beaked whale (<i>M. ginkgodens</i>)]	<i>Mesoplodon sp.</i>	Blainville's beaked whale is Target	0.0011125	0.0011125	1 to 11	4	Claridge, 2006
Killer whale	<i>Orcinus orca</i>	Non-target	0.0000812	0.0000812	2 to 15	7	Claridge, 2006
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Target	0.0003315	0.0003315	12 to 30	22.5	Barlow 2006
Risso's dolphin	<i>Grampus griseus</i>	Non-target	0.0180045	0.0540134	7 to 20	13.5	Claridge, 2006
Bottlenose dolphin	<i>Tursiops truncatus</i>	Non-target	0.0123205	0.0184808	10 to 25	18.8	Barlow, 2003

Common Name	Scientific Name	Target or Non-target species	SOCAL Warm Season density/km ²	SOCAL Cold Season density/km ²	Group Size	Assumed Mean Group Size	Source for Group Size
Striped dolphin	<i>Stenella coeruleoalba</i>	Non-target	0.0175442	0.0107019	10 to 100	37.3	Barlow 2006
Pacific white-sided dolphin	<i>Lagenorhynchus obliquidens</i>	Non-target	0.0160748	0.0160748	Large herds of hundreds to thousands, herds split into smaller groups when feeding, then reassemble to rest or travel	14	Moretti <i>et al</i> , 2008 (Leatherwood <i>et al</i> 1982)
Short-beaked common dolphin	<i>Delphinus delphis</i>	Target	0.8299606	0.315385	Herds range in size from several dozen to over 10,000. Bunch tightly together when frightened. Pattern of increasing group size in the morning and subsequent decline in the late afternoon or night.	354	Carretta <i>et al</i> 2000
Long-beaked common dolphin	<i>Delphinus capensis</i>	Non-target	0.0965747	0.0366984	Data often combined with short-beaked common dolphin	12	Moretti <i>et al</i> , 2008*
Northern right whale dolphin	<i>Lissodelphis borealis</i>	Target	0.0056284	0.0270163	Mean of 11 groups in SCIRC is 12.4	12.4	Carretta <i>et al</i> 2000
Dall's porpoise	<i>Phocoenoides dalli</i>	Non-target	0.0016877	0.0081008	Small groups of 2 to 12, mean of 8 groups was 3.4	3.4	Moretti <i>et al</i> , 2008*, Carretta <i>et al</i> 2000

Common Name	Scientific Name	Target or Non-target species	SOCAL Warm Season density/km ²	SOCAL Cold Season density/km ²	Group Size	Assumed Mean Group Size	Source for Group Size
CARNIVORES - Pinnipeds							
Northern fur seal	<i>Callorhinus ursinus</i>	Non-target	0.027	0.027	Unknown	2	Hypothesis***
Guadalupe fur seal	<i>Arctocephalus townsendi</i>	Non-target	0.007	0.007	Unknown	2	Hypothesis***
California sea lion	<i>Zalophus californianus</i>	Target	0.605	0.87	2.5 to 3.4	3	Smultea et al 2009
Northern elephant seal	<i>Mirounga angustirostris</i>	Non-target	0.042	0.025	1 group of 1 in SOCAL****	2	Smultea et al 2009
Harbor seal	<i>Phoca vitulina</i>	Target	0.19	0.19	1 to 1.7	2	Smultea et al 2009
Stellar sea lion	<i>Eumetopias jubatus</i>	Non-target	0	VERY RARE; last seen in northern Channel Islands in 1998	Unknown	2	Hypothesis***
CARNIVORES - Mustelid							
Southern Sea Otter	<i>Enhydra lutris nereis</i>	Non-target		Few sea otters venture beyond 1 mile from shore; rarely seen in SOCAL Range	Unknown	2	Hypothesis***

* Summary of sightings for 5-day October 2007 species verification test on the US Navy SOAR range.

** Applies to January-April only

*** Only limited information was found in the literature applicable for pinniped or mustelid group sizes out to sea; most documented work has largely described tagging of individuals or visual observations on rookeries. In absence of information, hypothesis here assumes that animals in these species venturing miles out to sea would likely travel and forage in ones/twos when well offshore.

**** Limited observation period during aerial monitoring yielded a single observation with a group size of 1. For conservative approach, adopted hypothesis that at times the animals would travel and forage in group of 2.

MYSTICETES

Blue whale, *Balaenoptera musculus*

In the North Pacific, the International Whaling Commission (IWC) began management of commercial whaling for blue whales in 1969; blue whales were fully protected from commercial whaling in 1976 (Allen 1980). They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the Marine Mammal Protection Act of 1972. Blue whales are listed as endangered on the IUCN Red List of Threatened Animals (Baillie and Groombridge 1996). Critical habitat has not been designated for blue whales. Blue whales are listed as endangered under the ESA, therefore the Eastern North Pacific Stock (formally the California/Oregon/Washington stock) is considered a depleted and strategic stock under the MMPA. Critical habitat for the blue whale has not been designated.

Blue whale population structure in the North Pacific remains uncertain, but two stocks are recognized within U.S. waters: the Hawaiian and the eastern North Pacific. The population estimate for this stock of blue whales is 1,368 (Coefficient of Variation [CV] = 0.22) individuals (Carretta *et al.* 2008). The abundance of blue whales along the California coast has been increasing during the past two decades (Calambokidis *et al.* 1990; Barlow 1994; Calambokidis 1995).

Blue whale occurrence off southern California in summer has been noted since 1990, particularly along the northern coasts of San Miguel, Santa Rosa, and Santa Cruz islands (Fiedler *et al.*, 1998). Blue whales feed on dense patches of euphausiid krill that are advected to the Channel island region within the California current. Oleson *et al.* (2007) reported on visual and acoustic monitoring conducted from April-November 2000-2003, which resulted in highest visual encounter rates in June and August. Whales were most often seen in the northern Channel Islands area surrounding San Miguel, Santa Rosa, and Santa Cruz islands and near Cortez Bank.

Acoustic encounters, including both calls and songs, occurred from June-November with highest encounter rates in early fall for songs and in July and August for calls. Acoustic encounter rates were highest near San Nicolas Island and the Cortez Bank region. Blue whales were also seen and heard, via hydrophone array, during CALCOFI cruises conducted from July 2004-November 2005 in the southern California Bight (Soldevilla *et al.*, 2006). Blue whales were both seen and heard during summer and fall cruises but not during winter or spring surveys. Sightings were scattered throughout the Channel Islands, and occurred both in near shore and offshore regions. Conversely, aerial surveys conducted in spring 1991 and 1992 resulted in only two sightings of blue whales along the entire California coast (Carretta and Forney, 1993).

Blue whales spend more than 94 percent of their time below the water's surface (Lagerquist *et al.* 2000). Blue whales feed on euphausiid crustaceans, including *Euphausia* sp and *Thysanoessa* sp. They have been documented feeding near the surface as well as at depths exceeding 140 m (Croll *et al.*, 2001). Data from southern California and Mexico showed that whales dived to >100 m for foraging; once at depth, vertical lunge-feeding often occurred (lunging after prey). Lunge-feeding at depth is energetically expensive and likely limits the deeper diving capability of blue whales. Foraging dives are deeper than traveling dives; traveling dives were generally to ~ 30m. Typical dive shape is somewhat V-shaped, although the bottom of the V is wide to

account for the vertical lunges at bottom of dive. Blue whales also have shallower foraging dives.

While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing. Based on vocalizations and anatomy, blue whales are assumed to hear only low-frequency sounds below 400 Hz (Croll *et al.* 2001; Stafford *et al.* 2005; Oleson *et al.* 2007).

In terms of functional hearing capability blue whales belong to the low-frequency group, which have the best hearing ranging from 7 Hz to 22 kHz (Southall *et al.* 2007). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of blue whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Fin whale, *Balaenoptera physalus*

In the North Pacific, the IWC began management of commercial whaling for fin whales in 1969; fin whales were fully protected from commercial whaling in 1976 (Allen 1980). Fin whales are listed as endangered under the ESA; therefore, the California/Oregon/Washington Stock is considered depleted and strategic under the MMPA. Critical habitat has not been designated for fin whales. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the Marine Mammal Protection Act of 1972. Fin whales are listed as endangered on the IUCN Red List of Threatened Animals (Baillie and Groombridge 1996). Critical habitat has not been designated for fin whales.

Fin whales occur in all oceans in temperate to polar latitudes, and many populations undergo seasonal migrations, from low latitude breeding areas to higher latitude feeding areas (Aguilar, 2002). This seasonal cycle is less defined in the northern hemisphere. There are considered to be three stocks in the North Pacific for management purposes: an Alaska Stock, a Hawaii Stock, and a California/Oregon/Washington Stock (Barlow *et al.* 1997). Currently, the best and most recent estimate for the California/Oregon/Washington Stock is 2,636 (CV = 0.15) individuals (Barlow and Forney 2007). Fin whales have been observed off southern California year round (Carretta *et al.* 2000).

Fin whales feed on planktonic crustaceans, including *Thysanoessa* sp and *Calanus* sp, as well as schooling fish including herring, capelin and mackerel (Aguilar, 2002). Fin whales typically dive for 5 to 15 min, separated by sequences of 4 to 5 blows at 10 to 20 sec intervals (Cetacean and Turtle Assessment Program (CETAP) 1982; Stone *et al.* 1992; Lafortuna *et al.* 2003). Kopelman and Sadove (1995) found significant differences in blow intervals, dive times, and blows per hour between surface feeding and non-surface-feeding fin whales. Goldbogen *et al.* (2006) studied fin whales in southern California and found that 60% of total time was spent diving, with the other 40% near surface (<50m); dives were to >225 m and were characterized by rapid gliding ascent, foraging lunges near the bottom of dive, and rapid ascent with flukes. Dives were somewhat V-shaped although the bottom of the V is wide.

Fin whales produce calls with the lowest frequency and highest source levels of all cetaceans. Infrasonic (10-60 Hz), pattern sounds have been documented for fin whales (Watkins *et al.* 1987; Clark and Fristrup 1997; McDonald and Fox 1999; Charif *et al.* 2002). Charif *et al.* (2002) estimated source levels between 159-184 decibels (dB) *re* 1 micro-Pascal (μ Pa)-1 m for fin whales vocalizations recorded between Oregon and Northern California. Fin whales can also produce a variety of sounds with a frequency range up to 750 Hz.

Although no studies have directly measured the sound sensitivity of fin whales, experts assume that fin whales are able to receive sound signals in roughly the same frequencies as the signals they produce. This suggests fin whales, like other baleen whales, are more likely to have their best hearing capacities at low frequencies, including infrasonic frequencies, rather than at mid- to high-frequencies (Ketten 1997).

In terms of functional hearing capability fin whales belong to the low-frequency group, which have the best hearing ranging from 7 Hz to 22 kHz (Southall *et al.* 2007). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of fin whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Sei whale, *Balaenoptera borealis*

Sei whales did not have meaningful protection at the international level until 1970, when catch quotas for the North Pacific began to be set on a species basis (rather than on the basis of total production, with six sei whales considered equivalent to one “blue whale unit”). Prior to that time, the kill was limited only to the extent that whalers hunted selectively for the larger species with greater return on effort (Allen 1980). The sei whale was given complete protection from commercial whaling in the North Pacific in 1976. In the late 1970's, some “pirate” whaling for sei whales took place in the eastern North Atlantic (Best 1992). There is no direct evidence of illegal whaling for this species in the North Pacific although the acknowledged misreporting of whaling data by Soviet authorities (Yablokov 1994) means that catch data are not wholly reliable. Sei whales are listed as endangered under the ESA and therefore classified as depleted and strategic stock under the MMPA. It is also classified as “endangered” by the IUCN (Baillie and Groombridge 1996) and is listed in CITES Appendix I. Critical habitat has not been designated for this species for the eastern North Pacific stock. Critical habitat has not been designated for this species for the Eastern North Pacific stock.

Sei whales occur in all oceans from subtropical to sub-arctic waters, and can be found on the shelf as well as in oceanic waters (Reeves *et al.*, 2002; Horwood, 2002). Sei whales are highly mobile, and there is no indication that any population remains in the same area year-round, i.e., is resident. Pole-ward summer feeding migrations occur, and sei whales generally winter in warm temperate or subtropical waters. They are known to occur off southern California, however, their distribution is poorly understood. The only stock estimate for US waters is for the eastern north Pacific stock offshore California, Oregon, and Washington (Carretta *et al.*, 2007). Sei whales were not seen during vessel surveys conducted off southern California in 1996, 2001,

or 2005 (Appler *et al.* 2004; Barlow 2003; Forney 2007) nor during aerial surveys conducted in 1991-92 or 1998-99 (Carretta and Forney 1993; Carretta *et al.*, 2000).

Sei whales feed on copepods, amphipods, euphausiids, shoaling fish and squid (Horwood, 2002). Stomach content analysis indicated that they are likely skim feeders that take in swarms in low density. There have been no depth distribution data collected on this somewhat elusive species.

In terms of functional hearing capability, sei whales belong to low-frequency cetaceans that have the best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific sei whale hearing ranges. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of sei whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Bryde's whale, *Balaenoptera edeni*

Bryde's whales are found mainly in tropical and temperate waters, in areas of high productivity where water temperature is at least 16.3°C (Reeves *et al.*, 2002; Kato, 2002). The best estimate of the entire eastern tropical Pacific population size is 13,000 (CV=0.20) individuals, with only an estimated 12 (CV=2.0) individuals in California, Oregon, and Washington waters (Carretta *et al.* 2007). Only one Bryde's whale has ever been positively identified in surveys of California coastal waters (Barlow 1994). Recent surveys have not observed any Bryde's whales in Southern California (Barlow and Forney 2007; Forney 2007) and the species was taken out of the 2008 draft Stock Assessment Report (Carretta *et al.* 2008).

Bryde's whales feed on pelagic schooling fish, small crustaceans including euphausiids and copepods and cephalopods (Kato 2002). Feeding appears to be regionally different. Off South Africa, the inshore form feeds on epipelagic fish while the offshore form feeds on mesopelagic fish and euphausiids (Best 1977; Bannister 2002). Stomach content analysis from whales in the southern Pacific and Indian oceans indicated that most feeding apparently occurred at dawn and dusk, and were primarily euphausiids (Kawamura, 1980). There have been no depth distribution data collected on Bryde's whales.

There is no information on the hearing of Bryde's whales, but Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing. In terms of functional hearing capability Bryde's whales belong to low-frequency cetaceans that have the best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific Bryde's whale hearing ranges. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of Bryde's whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Minke whale, *Balaenoptera acutorostrata*

Minke whales are the smallest of all mysticete whales. They are widely distributed in the north Atlantic and Pacific. They can be found in near shore shallow waters and have been detected acoustically in offshore deep waters. Most minke whale populations inhabit colder waters in summer and migrate to warmer regions in winter (Perrin and Brownell, 2002). The population abundance for offshore California/Oregon/Washington stock is estimated to be 823 (CV=0.56) minke whales with 226 (CV=1.02) in Southern California waters (Barlow and Forney 2007). The NMFS Stock Assessment Report gives an estimate of 806(CV=0.63) minke whales in the California/Oregon/ Washington stock (Carretta *et al.* 2008).

Minke whales feed on small schooling fish and krill, and are the smallest of all balaenopterid species, which may affect their ability to dive. The only depth distribution data for this species are reported from a study on daily energy expenditure conducted off northern Norway and Svalbard (Blix and Folkow, 1995). The limited depth information available (from Figure 2 in Blix and Folkow, 1995) is representative of a 75-min diving sequence where the whale was apparently searching for capelin, then foraging, then searching for another school of capelin. Search dives were mostly to ~20 m, while foraging dives were to 65 m.

While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing. In terms of functional hearing capability minke whales belong to low-frequency cetaceans that have the best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific minke whale hearing ranges. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of minke whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Humpback whale, *Megaptera novaeangliae*

Humpback whales are listed as endangered under the ESA and therefore are classified as depleted and strategic stock under the MMPA. Critical habitat has not been designated for this species in waters off California, Oregon, and Washington. The IWC first protected humpback whales in the North Pacific in 1966. They are also protected under the Convention on International Trade in Endangered Species (CITES).

Humpback whales are found in all oceans, in both coastal and continental waters as well as near seamounts and deep water during migration (Reeves *et al.*, 2002; Clapham, 2002). Some populations have been extensively studied (e.g., Hawaii, Alaska, Caribbean), and details about migratory timing, feeding and breeding areas are fairly well known. Humpbacks are highly migratory, feeding in summer at mid and high latitudes and calving and breeding in winter in tropical or subtropical waters. Humpbacks of the Eastern North Pacific stock appear to spend winter and spring near Central America and Mexico and migrate north to feeding areas off California, Oregon, Washington and British Columbia in summer and fall (Carretta *et al.*, 2007). The NMFS Stock Assessment Report estimate of population size for the California/Oregon/

Washington Stock is 1,391 (CV = 0.13; Carretta *et al.* 2008). Calambokidis *et al.* (2008) estimated that 1,400 to 1,700 humpback whales use the California/Oregon waters.

Humpback whales feed on pelagic schooling euphausiids and small fish including capelin, herring, and mackerel (Clapham, 2002). Like other large mysticetes, they are a “lunge feeder” taking advantage of dense prey patches and engulfing as much food as possible in a single gulp. They also blow nets, or curtains, of bubbles around or below prey patches to concentrate the prey in one area, then lunge with mouths open through the middle. Dives appear to be closely correlated with the depths of prey patches, which vary from location to location. In the north Pacific, most dives were of fairly short duration (<4 min) with the deepest dive to 148 m (southeast Alaska; Dolphin, 1987), while whales observed feeding on Stellwagen Bank in the North Atlantic dove to <40 m (Hain *et al.*, 1995).

In terms of functional hearing capability, humpback whales belong to low-frequency cetaceans that have the best hearing ranging from 7 Hz to 22 kHz (Southall *et al.* 2007). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of humpback whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Gray whale, *Eschrichtius robustus*

Gray whales inhabit shallow coastal waters of the northeastern Pacific, from Baja California north to Arctic Alaska (a separate small remnant stock of gray whales also ranges in the northwestern Pacific). The Eastern North Pacific stock was believed to consist of 18,813 (CV=0.07) individuals in 2002 (Anglis and Allen 2008).

Gray whales from the Eastern North Pacific stock undertake a well-documented migration from winter calving lagoons in Baja California to summer feeding areas in the Bering and Chukchi seas (Swartz *et al.*, 2006). The migration route is primarily near shore in shallow water, although gray whales have been documented swimming offshore near the Channel Islands in the Southern California Bight. Almost all of the population passes through the SOCAL Range Complex during both the northward and the southward migration. Gray whales are common there only during cold-water months; none were sighted in the warm season (May–October) in the 1998–1999 NMFS surveys of the SCIRC (Carretta *et al.* 2000). Southbound and northbound migrations through the SOCAL Range Complex occur, for the most part, at predictable times. The southbound migration begins in the third week of December, peaks in January, and extends through February (Gilmore 1960; Leatherwood 1974). The northbound migration generally begins in mid-February, peaks in March, and lasts at least through May. Gray whales do not spend much time feeding in the Range Complex. Northbound mothers and calves travel more slowly than other whales, and tend to be seen later in the season. Not all gray whales make the full migration south to wintering areas; a “resident” Pacific Feeding Aggregation estimated at ~300 whales remains offshore northern California to southeast Alaska (Calambokidis *et al.* 2004).

Behavior, including diving depth and frequency, can vary greatly between geographic regions. Gray whales feed on the bottom, mainly on benthic amphipods that are filtered from the sediment (Jones and Swartz, 2002), so dive depth is dependent on depth at location for foraging whales. Mate and Urban Ramirez (2003) noted that 30 of 36 locations for a migratory gray whale with a satellite tag were in water <100m deep, with the deeper water locations all in the southern California Bight within the Channel Islands. Whales in that study maintained consistent speed indicating directed movement. There has been only one study yielding a gray whale dive profile, and all information was collected from a single animal that was foraging off the west coast of Vancouver Island (Malcolm and Duffus, 2000; Malcolm *et al.*, 1995/96). They noted that the majority of time was spent near the surface on inter-ventilation dives (<3 m depth) and near the bottom (extremely nearshore in a protected bay with mean dive depth of 18 m, range 14-22 m depth). There was very little time spent in the water column between surface and bottom. Foraging depth on summer feeding grounds is generally between 50-60 m (Jones and Swartz, 2002).

The structure of the gray whale ear is evolved for low-frequency hearing (Ketten, 1992). The ability of gray whales to hear frequencies below 2 kHz has been demonstrated in playback studies (Cummings and Thompson 1971; Dahlheim and Ljungblad 1990; Moore and Clarke 2002) and in their responsiveness to underwater noise associated with oil and gas activities (Malme *et al.* 1986; Moore and Clarke 2002). Gray whale responses to noise include changes in swimming speed and direction to move away from the sound source; abrupt behavioral changes from feeding to avoidance, with a resumption of feeding after exposure; changes in calling rates and call structure; and changes in surface behavior, usually from traveling to milling (e.g., Moore and Clarke 2002).

ODONTOCETES

Sperm whale, *Physeter macrocephalus*

Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). Sperm whales are listed as endangered under the ESA and therefore are considered depleted and strategic under the MMPA. Critical habitat has not been designated for sperm whales. They are also protected by the Convention on International Trade in Endangered Species and the Marine Mammal Protection Act of 1972.

Sperm whales are most often found in deep water, near submarine canyons, and along the edges of banks, over continental slopes and particularly in regions of upwelling and high primary productivity (Whitehead, 2002; Reeves *et al.*, 2002). Adult males range farther north than females and juvenile males which tend to inhabit waters >1000 m and 50°N in the north Pacific. In the deeper waters off southern California, both sexes and all age classes would likely be found year round. The sperm whale population is estimated to be 1,934 (CV=0.31) for the California/Oregon/Washington Stock (Barlow and Forney 2007). The NMFS Stock Assessment Report provides an estimate of 2,853 (CV=0.25) sperm whales for the California/Oregon/Washington Stock (Carretta *et al.* 2008). Vessel surveys conducted in 2001 and 2005 both yielded sightings of sperm whales (Forney, 2007; Appler *et al.*, 2004).

Sperm whales forage during deep dives that routinely exceed a depth of 1,314 ft and 30 min duration (Watkins *et al.* 2002). Sperm whales are capable of diving to depths of over 6,564 ft with durations of over 60 min (Watkins *et al.*, 1993). Sperm whales spend up to 83 percent of daylight hours underwater (Jaquet *et al.* 2000; Amano and Yoshioka 2003). Males do not spend extensive periods of time at the surface (Jaquet *et al.* 2000). In contrast, females spend prolonged periods of time at the surface (1 to 5 hours daily) without foraging (Whitehead and Weilgart 1991; Amano and Yoshioka 2003).

Sperm whales feed on large and medium-sized squid, octopus, rays, and sharks, on or near the ocean floor. Some evidence suggests that they do not always dive to the bottom of the sea floor (likely if food is elsewhere in the water column), but that they do generally feed at the bottom of the dive. Davis *et al.* (2007) report that dive-depths (100-500 m) of sperm whales in the Gulf of California overlapped with depth distributions (200-400 m) of jumbo squid, based on data from satellite-linked dive recorders placed on both species, particularly during daytime hours. Their research also showed that sperm whales foraged throughout a 24-hour period, and that they rarely dove to the sea floor bottom (>1000 m). The most consistent sperm whale dive type is U-shaped, whereby the whale makes a rapid descent to the bottom of the dive, forages at various velocities while at depth (likely while chasing prey) and then ascends rapidly to the surface.

The anatomy of the sperm whale's ear indicates that it hears high-frequency sounds and has some ultrasonic hearing (Ketten 1992). Anatomical studies also suggest that the sperm whale has some high-frequency hearing, but at a lower maximum frequency than many other odontocetes (Ketten, 1992). The sperm whale may also possess better low-frequency hearing than some other odontocetes, although not as extraordinarily low as many baleen whales (Ketten, 1992). The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway 1990). These data suggest that neonatal sperm whales respond to sounds from 2.5- 60 kHz with the highest sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder 2001).

Sperm whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall *et al.* 2007). The intersection of common frequencies between sperm whale functional hearing and typical mid- and high-frequency sonars suggests that more often than not there is a potential for a behavioral response. But as a result of having a functional range lower than the mid-frequency active sonars, there is still some likelihood low-frequency vocalizations and sound-dependent behaviors may not be disrupted or may only be partially disrupted or masked.

Pygmy sperm whales, *Kogia breviceps*

Pygmy (*Kogia breviceps*) and dwarf (*Kogia sima*) sperm whales are difficult to differentiate at-sea, and are therefore often recorded as *Kogia sp.* during survey efforts. The distribution of both species is generally temperate to tropical and probably seaward of the continental shelf (McAlpine, 2002; Reeves *et al.*, 2002); there is some evidence that dwarf sperm whales prefer somewhat warmer waters than do pygmy sperm whales. The size of the California/Oregon/Washington Stock is unknown (Carretta *et al.* 2008). Barlow and Forney (2007) estimated the *Kogia* spp. population at 1,237 (CV=0.45). This estimate did not differentiate between the two species of *Kogia*, but dwarf sperm whales are rarely observed in California waters and therefore

this estimate is most likely pygmy sperm whales. There were no sightings of *Kogia* during vessel surveys conducted in 2005 (Forney, 2007) and one sighting off central California in 2001 (Appler *et al.*, 2004).

There are no depth distribution data for this species. An attempt to record dive information on a rehabbed pygmy sperm whale failed when the TDR package was never recovered (Scott *et al.*, 2001). Prey preference, based on stomach content analysis from Atlantic Canada (McAlpine *et al.*, 1997) and New Zealand (Beatson, 2007), appears to be mid and deep water cephalopods, crustaceans and fish. There is some evidence that they may use suction feeding and feed at or near the bottom. They may also take advantage of prey undergoing vertical migrations to shallower waters at night (Beatson, 2007b).

An auditory brainstem response study indicates that pygmy sperm whales have their best hearing between 90 and 150 kHz (Ridgway and Carder 2001).

Cuvier's beaked whale, *Ziphius cavirostris*

Cuvier's beaked whale has the widest distribution of all beaked whales, and occurs in all oceans. It is most often found in deep offshore waters, and appears to prefer slope waters with steep depth gradients. As with most beaked whales, Cuvier's are fairly cryptic at-sea and therefore difficult to sight and identify. Population size for the California/Oregon/Washington Cuvier's beaked whale stock is estimated to be 4,342 (CV=0.58) individuals (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are 2,830 (CV=0.73) Cuvier's beaked whales in the waters of California, Oregon, and Washington (Carretta *et al.* 2008).

The distribution and abundance of beaked whales in the SOCAL Range Complex are not well known because they are difficult to identify; many of the beaked whales sighted have not been identified to species. Based on those that were identified, Cuvier's beaked whale appears to be the most abundant beaked whale in the area, representing almost 80% of the identified beaked whale sightings (Barlow and Gerrodette 1996). While they are sighted only during the cold-water season, it is unknown if Cuvier's beaked whales are found in the SOCAL Range Complex year- round or shift distribution.

Cuvier's beaked whales are generally sighted in waters with a bottom depth greater than about 650 ft and are frequently recorded at depths of 3,282 ft or more (Gannier 2000; MacLeod *et al.* 2004). They are commonly sighted around seamounts, escarpments, and canyons. Cuvier's feed on mesopelagic or deep-water benthic organisms, particularly squid (Heyning, 2002). Stomach content analysis indicates that they take advantage of a larger range of prey species than do other deep divers (e.g., Santos *et al.*, 2001; Blanco and Raga, 2000). Cuvier's, like other beaked whales, are likely suction feeders based on the relative lack of teeth and enlarged hyoid bone and tongue muscles. Foraging dive patterns appear to be U-shaped, although inter-ventilation dives are shallower and have a parabolic shape (Baird *et al.*, 2006a).

Depth distribution studies in Hawaii (Baird *et al.*, 2005a; Baird *et al.*, 2006a) found that Cuvier's undertook three or four different types of dives, including intermediate (to depths of 292-568 m), deep (>1000 m) and short-inter-ventilation (within 2-3 m of surface); this study was of a single animal. Studies in the Ligurian Sea indicated that Cuvier's beaked whales dived to >1000 m and

usually started “clicking” (actively searching for prey) around 475 m (Johnson *et al.*, 2004; Soto *et al.*, 2006). Clicking continued at depths and ceased once ascent to the surface began, indicating active foraging at depth. In both locations, Cuvier’s spent more time in deeper water than did Blainville’s beaked whale, although maximum dive depths were similar. There was no significant difference between day and night diving indicating that preferred prey likely does not undergo vertical migrations.

There is no information on the hearing abilities of Cuvier’s beaked whales. Beaked whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall *et al.* 2007) though the best hearing is presumed to occur at ultrasonic frequencies (MacLeod 1999; Ketten 2000). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod 1999; Ketten 2000). The only direct measure of beaked whale hearing is from a stranded juvenile Gervais’ beaked whale using auditory evoked potential techniques (Cook *et al.* 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook *et al.* 2006). Some have proposed a potential association between beak whale strandings and active sonar activities, noting five recurring factors in common with each stranding event: use of mid-frequency sonar, beaked whale presence, surface ducts, steep bathymetry, and constricted channels with limited egress. These five factors would not occur simultaneously at the proposed research location within the SOCAL Range Complex. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of beaked whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Baird’s beaked whale, *Berardius bairdii*

Baird’s beaked whales, like most beaked whales, are a deep-water species that inhabits the north Pacific. They generally occur close to shore only in areas with a narrow continental shelf. Population size for the California/Oregon/Washington Stock is estimated to be 1,005 (CV=0.37) individuals (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates that there 540 (CV=0.54) Baird’s beaked whales in the waters of California, Oregon, and Washington (Carretta *et al.* 2008).

Baird’s beaked whales appear to occur mainly in deep waters over the continental slope, oceanic seamounts, and areas with submarine escarpments (Ohsumi 1983; Kasuya and Ohsumi 1984; Willis and Baird 1998; Kasuya 2002). They may be seen close to shore where deep water approaches the coast (Jefferson *et al.* 1993). Analysis of stomach contents from captured and stranded individuals suggests that beaked whales are deep-diving animals, feeding by suction (Heyning and Mead 1996). The Baird’s beaked whale, feeds mainly on benthic fishes and cephalopods, but occasionally on pelagic fish such as mackerel, sardine, and saury (Kasuya 2002; Walker *et al.* 2002; Ohizumi *et al.* 2003). Baird *et al.* (2006a) reported on the diving behavior of four Blainville’s beaked whales (a similar species) off the west coast of Hawaii. The four beaked whales foraged in deep ocean areas (2,270-9,855ft) with a maximum dive to 4,619 ft. Dives ranged from at least 13 min (lost dive recorder during the dive) to a maximum of

68 min (Baird *et al.* 2006a). The overall dive behavior of this beaked whale is not known (e.g., shape of dive, inter-ventilation dives, etc).

As discussed previously for Cuvier's beaked whales, beaked whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall *et al.* 2007) though the best hearing is presumed to occur at ultrasonic frequencies (MacLeod 1999; Ketten 2000). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod 1999; Ketten 2000).

Beaked whale species, *Mesoplodon* sp, including Hubb's, *Mesoplodon carlhubbsi*, ginkgo-toothed, *M. ginkgodens*, Blainville's, *M. densirostris*, Perrin's, *M. perrini*, and pygmy, *M. peruvianus*

Mesoplodonts are difficult to distinguish in the field. Five species of Mesoplodont may occur off the coast of Southern California: Blainville's beaked whale (*M. densirostris*), Hubb's beaked whale (*M. carlhubbsi*), Perrin's beaked whale (*M. perrini*), pygmy beaked whale (*M. peruvianus*), and ginkgo-toothed beaked whale (*M. ginkgodens*) (Mead 1989). Hubb's beaked whales are known only from temperate waters of the North Pacific, mainly along the west coast of North America (Reeves *et al.*, 2002; Pitman, 2002b). Ginkgo-toothed whales are distributed in warm temperate and tropical waters of the Pacific and Indian oceans. Stejneger's beaked whale ranges across arctic and cool temperate waters from Baja California to Japan. Blainville's are distributed circumglobally in tropical and warm temperate waters. Pygmy beaked whales are known from the eastern Pacific from northern Mexico to northern Chile. Very little is known about the behavior of any of these species, as they are cryptic and difficult to sight at-sea. Unidentified Mesoplodonts have been sighted during most vessel cruises conducted offshore California, but very few can be identified to species (with the exception of *M. densirostris*). Population size of California/Oregon/Washington Stock of Mesoplodont beaked whales is estimated to be 1,177 (CV=0.40) individuals (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are 1,024 (CV=0.77) Mesoplodont species in the waters of California, Oregon, and Washington (Carretta *et al.* 2008).

Mesoplodon sp. feeds primarily on mesopelagic squid and some fish, with most prey likely caught at >200 m (Pitman, 2002b). Like other beaked whales, they are believed to be suction feeders. There are no depth distribution data for *Mesoplodon* species as a group, however good dive information has been collected on *Mesoplodon densirostris* in Hawaii (Baird *et al.*, 2006a; 2005a) and the Canary Islands (Tyack *et al.*, 2006). Baird *et al.* (2006) reported on the diving behavior of four Blainville's beaked whales off the west coast of Hawaii. The four beaked whales foraged in deep ocean areas (2,270 to 9,855ft) with a maximum dive to 4,619 ft. Dives ranged from at least 13 min (lost dive recorder during the dive) to a maximum of 68 min (Baird *et al.* 2006).

Beaked whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall *et al.* 2007) though the best hearing is presumed to occur at ultrasonic frequencies (MacLeod 1999; Ketten 2000). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod 1999; Ketten 2000).

Killer whale, *Orcinus orca*

Killer whales are one of the most widely distributed mammal species in the world and are found in all oceans (Ford, 2002). Killer whales are segregated socially, genetically, and ecologically into three distinct groups: residents, transients, and offshore animals. Offshore whales do not appear to mix with the other types of killer whales (Black *et al.* 1997; Dahlheim and Heyning 1999). Most of the killer whales off California are from transient and offshore groups. Of the three stocks of killer whales, Eastern North Pacific (ENP) Southern Residents, ENP Offshores, and ENP transients, only the ENP Southern Resident stock is listed as endangered under the ESA.

It is likely that only the Eastern North Pacific Offshore Stock ventures into waters off southern California (Carretta *et al.*, 2007). The ENP Offshore stock is found year-round ranging from offshore California north to offshore Washington and occasionally British Columbia, and apparently feeds primarily on fish. Killer whales were seen off southern California during vessel surveys conducted in 2005 (Forney, 2007). Population size for all killer whales (this includes all offshore and transient stocks) along the coasts of California, Oregon, and Washington is estimated to be 353 (CV=0.29) individuals (Carretta *et al.* 2008).

Killer whales feed on a variety of prey, including salmon, herring, cod, tuna, and cephalopods (Ford, 2002). “Transient” stocks of killer whales feed on other marine mammals, including other whales, pinnipeds (e.g., London, 2006), and sea otters (e.g., Estes, 1998). Diving studies on killer whales have been undertaken mainly on “resident” (fish-eating) killer whales in Puget Sound and may not be applicable across all populations of killer whales. Diving is usually related to foraging, and mammal-eating killer whales may display different dive patterns. Killer whales in one study (Baird *et al.*, 2005b) dove as deep as 264 m, and males dove more frequently and more often to depths >100 m than females, with fewer deep dives at night. Dives to deeper depths were often characterized by velocity bursts that may be associated with foraging or social activities. Using best available data from Baird *et al.* (2003a), it would appear that killer whales spend ~4% of time at depths >98 ft. and 96% of time at depths 0-98 ft.

The killer whale has the lowest frequency of maximum sensitivity and one of the lowest high frequency hearing limits known among toothed whales (Szymanski *et al.* 1999). The upper limit of hearing is 100 kHz for this species. The most sensitive frequency, in both behavioral and in auditory brainstem response audiograms, has been determined to be 20 kHz (Szymanski *et al.* 1999).

Functional hearing for killer whales is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall *et al.* 2007). Killer whales can hear a frequency range of 1 to 100 kHz and are most sensitive at 20 kHz (Szymanski *et al.* 1999). Social sounds range from 0.5 to 25 kHz with the dominant frequency range between 1 to 6 kHz. This overlap with mid-frequency active and high-frequency active sonar frequencies suggests a potential for active sonar to interfere with sounds associated with social behavior. Foraging frequencies for one study noted a center frequency ranging from 45 to 80 kHz, which overlaps well with high-frequency active sonar. Thus, use of either mid-frequency active or high-frequency active sonar could overlap a part of this species’ broad functional hearing and communication range. High-frequency active frequencies above 80 kHz may or may not result

in a response. If a killer whale does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Short-finned pilot whale, *Globicephala macrorhynchus*

The short-finned pilot whale is not listed under the ESA; however, the California/Oregon/Washington Stock is considered strategic under the MMPA because the average human-caused mortality may not be sustainable (Barlow *et al.* 1997). Population size for the California/Oregon/Washington Stock is 350 (CV=0.48) individuals (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are 245 (CV=0.97) short-finned pilot whales in the waters of California, Oregon, and Washington (Carretta *et al.* 2008).

This species is known from tropical and warm temperate waters, and is found primarily near continental shelf breaks, slope waters, and areas of high topographic relief (Olson and Reilly, 2002). It was once common in the waters off southern California, and there may have been a resident group of 20-30 animals in the Catalina Channel. However, this species has not been observed with any regularity since a strong El Nino event in 1982-83 (Carretta *et al.*, 2007). There was a single sighting off southern California during vessel surveys in 2005 (Forney, 2007).

Pilot whales are deep divers; the maximum dive depth measured is about 3,186 ft (Baird *et al.* 2002). The only study conducted on short-finned pilot whales in Hawaii has not been published in any detail (Baird *et al.*, 2003b), but an abstract indicated that there were significant differences between day and night diving; dives of >100m were far more frequent at night, likely to take advantage of vertically-migrating prey; night dives regularly went to 300-500 m. Deepest dives were during the day, however, perhaps because prey was deeper.

Short-finned pilot whales feed on squid and fish. Pilot whales are not generally known to prey on other marine mammals; however, records from the eastern tropical Pacific suggest that the short-finned pilot whale does occasionally chase, attack, and may eat dolphins during fishery operations (Perryman and Foster 1980), and they have been observed harassing sperm whales in the Gulf of Mexico (Weller *et al.* 1996).

Functional hearing for pilot whales is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall *et al.* 2007). Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz. Communication frequencies for pilot whales therefore align well with both mid-frequency active and high-frequency active sonar frequencies. High-frequency active sonar frequencies above 60 kHz may or may not result in a response. If a pilot whale does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Risso's dolphin, *Grampus griseus*

This species is known from tropical and warm temperate oceans, primarily in waters with surface temperatures between 50 and 82°F (Reeves *et al.*, 2002). They are primarily found in water depths from 400-1000 m but are also found on the continental shelf. The population estimate of

the California/Oregon/Washington Stock is 11,910 (CV=0.24) individuals (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are 11,621 (CV=0.17) Risso's dolphins in the waters of California, Oregon and Washington (Carretta *et al.* 2008).

Risso's dolphins have been sighted in waters of the SOCAL Range Complex during all seasons. However, in most years, higher numbers are present during the cold-water months than during other times of the year (Forney and Barlow 1998). Risso's dolphins are found in the SOCAL Range Complex throughout the year (Carretta *et al.* 2000). Most sightings in the study area have been well offshore, but Risso's dolphins have been sighted close to the eastern shore of San Clemente Island during the cold season (Carretta *et al.* 2000). Risso's dolphins occur individually or in small to moderate-sized groups, normally ranging in numbers from 2 to nearly 250. The majority of groups contain fewer than 50 (Leatherwood *et al.* 1980; Carretta *et al.* 2000), however group sizes may reach as high as 2,500.

There are no depth distribution data for this species. They are primarily squid eaters and feeding is presumed to take place at night. A study undertaken in the Gulf of Mexico demonstrated that Risso's are distributed non-uniformly with respect to depth and depth gradient (Baumgartner, 1997), utilizing mainly the steep sections of upper continental slope bounded by the 350 m and 975 m isobaths. That data agrees closely with Blanco *et al.* (2006), who collected stomach samples from stranded Risso's dolphins in the western Mediterranean. Their results indicate that, based on prey items, Risso's feed on the middle slope at depths ranging from 600-800 m. Stomach content analysis from three animals elsewhere in the Mediterranean indicated that Risso's fed on species that showed greater vertical migrations than those ingested by striped dolphins (Ozturk *et al.*, 2007).

Functional hearing for Risso's dolphins is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall *et al.* 2007). Nachtigall *et al.* (1995; 2005) measured hearing in an adult and an infant Risso's dolphin. The adult hearing ranged from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. The infant could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz, well above mid-frequency active sonar frequencies but well within the high-frequency active sonar frequency range. The intersection of common frequencies between Risso's dolphin best hearing sensitivity and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.

Bottlenose dolphin, *Tursiops truncatus*

Bottlenose dolphins are distributed in all oceans from temperate to tropical latitudes. In the eastern north Pacific, the distribution extends to about Central California, although distribution in the western north Pacific and Atlantic oceans extends much farther north (Wells and Scott, 2002). Bottlenose dolphins are primarily coastal, but can also be found on the continental slope, shelf, and shelf break. In southern California, there are two stocks of bottlenose dolphins including a coastal stock that does not venture >500 m from shore (Carretta *et al.*, 2007) and an offshore stock that is distributed beyond 500 m offshore to at least 300 nm offshore. Population size for the California/Oregon/Washington bottlenose dolphin offshore stock is estimated to be 2,026 (CV=0.54) bottlenose dolphins with 1,831 (CV=0.47) individuals in Southern California waters (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are

3,495 (CV=0.31) offshore bottlenose dolphins in the waters of California, Oregon, and Washington (Carretta *et al.* 2008).

There have been several studies on bottlenose dolphin feeding preferences, which illustrate variation in location. Rossbach and Herzing (1997) observed bottlenose dolphins in the Bahamas feeding on the bottom (7-13 m) by orienting their heads down and moving from side to side, and several species regularly fed on occur along the sea floor (Wells and Scott, 2002). Corkeron and Martin (2004) reported that two dolphins spent 66% percent of time in top 5 m of water surface; maximum dive depth was greater than 150 m and there was no apparent diurnal pattern. Klatsky *et al.* (2007) reported on dive data of dolphins tagged at the Bermuda Pedestal in the north Atlantic. Dolphins dove to at least 492 m depth, with deep dives (>100 m) occurring exclusively at night. Dives during the day were shallower than at night, with 90% of all dives to within 50 m of the surface.

Functional hearing for bottlenose dolphins is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall *et al.* 2007) with peaks in sensitivity at 25 and 50 kHz (Nachtigall *et al.* 2000). Bottlenose dolphins communicate via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high-frequency sonar. Signature whistles, which identify individual dolphins and are a dominant characteristic of communications between mothers and calves, range from 3.4 to 14.5 kHz, comparable to the 1 to 10 kHz range of mid-frequency active sonar. Potential Level B harassment exposures from mid-frequency active sonar could therefore result in impaired communication between mother and calf pairs. In addition, experiments support the likelihood that some high-frequency active sonar frequencies could result in a behavioral response. Observed changes in behavior in one bottlenose dolphin were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 μ Pa-m (Ridgway *et al.* 1997; Schlundt *et al.* 2000).

Exposure to mid-frequency active sonar that is below, or to high-frequency active sonar that is above, the functional hearing capability of bottlenose dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range. Any behavioral responses that do occur are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures. Thus, interruptions in communication and other activities would be temporary.

Striped dolphin, *Stenella coeruleoalba*

Striped dolphins are distributed in tropical and warm temperate waters of all oceans. In the eastern north Pacific, their distribution extends as far north as ~43°N (Archer, 2002). The best estimate of the size of the California/Oregon/Washington Stock is 18,976 (CV=0.28) individuals (Barlow and Forney 2007). According to the NMFS Stock Assessment Report, the size of the California/Oregon/Washington Stock is 17,925 (CV=0.37) individuals (Carretta *et al.* 2008). Striped dolphins were seen offshore southern California during surveys conducted in 2005 as well (Forney, 2007).

In and near the SOCAL Range Complex, striped dolphins are found mostly offshore, and are much more common in the warm-water period. Striped dolphins are found in the SOCAL Range Complex throughout the year (Waring *et al.* 2002). Striped dolphins are gregarious (groups of 20 or more are common) and active at the surface (Whitehead *et al.* 1998).

Striped dolphins feed on pelagic fish and squid and may dive during feeding to depths exceeding 200 m (Archer, 2002). There is some evidence that striped dolphins feed at night to take advantage of vertical migrations of the deep scattering layer.

The striped dolphin's range of most sensitive hearing is 29 to 123 kHz using standard psycho-acoustic techniques, maximum sensitivity occurred at 64 kHz (Kastelein *et al.* 2003). Hearing ability became less sensitive below 32 kHz and above 120 kHz (Kastelein *et al.* 2003).

Functional hearing for striped dolphins is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall *et al.* 2007). Kastelein *et al.* (2003) determined the hearing sensitivity of a single striped dolphin to range from 0.5 to 160 kHz with best sensitivity at 64 kHz. Assuming this study may be applicable to striped dolphins in general, the frequency of best sensitivity for this species is much higher than the range of frequencies for mid-frequency active sonar but aligns well with that of high-frequency active sonar. Dominant frequencies of whistles ranged from 8 to 12.5 kHz (Thomson and Richardson 1995). The intersection of common frequencies between striped dolphin functional hearing and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.

Pacific white-sided dolphin, *Lagenorhynchus obliquidens*

Pacific white-sided dolphins range throughout the north Pacific in cold temperate waters. Movements between inshore/offshore and north/south are not well understood, but most sightings are in shelf and slope waters and distribution appears to shift northward off Oregon and Washington in late spring and summer (Carretta *et al.*, 2007). The size of the California/Oregon/Washington Stock is estimated to be 23,817 (CV=0.36) individuals (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are 20,719 (CV=0.22) Pacific white-sided dolphins in the waters of California, Oregon, and Washington (Carretta *et al.* 2008).

The Pacific white-sided dolphin is most common in waters over the continental shelf and slope. Sighting records and captures in pelagic driftnets indicate that this species occurs in oceanic waters well beyond the shelf and slope (Leatherwood *et al.* 1984; Ferrero and Walker 1999). The Pacific white-sided dolphin occurs across temperate Pacific waters, to latitudes as low as (or lower than) 38°N, and northward to the Bering Sea and coastal areas of southeast Alaska (Leatherwood *et al.* 1984). Surveys suggest a seasonal north-south movement of Pacific white-sided dolphins in the eastern North Pacific, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase during late spring and summer (Green *et al.* 1992; Forney 1994; Carretta *et al.* 2007). Peak abundance in California waters occurs from November to April (Leatherwood *et al.* 1984). Pacific white-sided dolphins are found in the SOCAL Range Complex throughout the year (Carretta *et al.* 2007).

Pacific white-sided dolphins are generalist feeders (Van Waarebeek and Wursig, 2002). This does not appear to be a deep-diving species. Satellite tag studies of a rehabilitated related species (*Lagenorhynchus acutus*) in the Gulf of Maine indicated that nearly all time was spent in waters <100 m total depth with largely directed movement (Mate *et al.*, 1994). Another related species, *Lagenorhynchus obscurus*, was observed feeding in two circumstances; at night to 130 m depth to take advantage of the deep scattering layer closer to the surface and during the day in shallower depths (<65 m) where they fed on schooling fish (Benoit-Bird *et al.*, 2004).

Tremel *et al.* (1998) measured the underwater hearing sensitivity of the Pacific white-sided dolphin from 75 Hz through 150 kHz with the greatest sensitivities from 4 to 128 kHz. Below 8 Hz and above 100 kHz, this dolphin's hearing was similar to that of other toothed whales.

Short-beaked common dolphin, *Delphinus delphis*

Short-beaked common dolphins are found in continental shelf waters of the Atlantic and Pacific, as well as pelagic waters of the eastern tropical Pacific and Hawaii (Reeves *et al.*, 2002; Perrin, 2002b). The short-beaked common dolphin is the most abundant cetacean off California (Dohl *et al.* 1981; Forney *et al.* 1995; Carretta *et al.* 2007). The single current management unit for the short-beaked common dolphin in this area is a California/Oregon/Washington Stock with a population estimate of 352,069 (CV=0.18) individuals (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are 392,733 (CV=0.18) short-beaked common dolphins in the waters of California, Oregon, and Washington (Carretta *et al.* 2008). The abundance of common dolphins varies seasonally but may be increasing in California with a northward shift in the population (Heyning and Perrin 1994; Barlow *et al.* 1997; Forney 1997).

Dependent on habitat and location, common dolphins feed on small schooling fish, squid, and crustaceans. They appear to take advantage of the deep scattering layer at dusk and during early night-time hours, when the layer migrates closer to the water surface, as several prey species identified from stomach contents are known to vertically migrate (e.g., Ohizumi *et al.*, 1998; Pusineri *et al.*, 2007). Perrin (2002b) reports foraging dives to 200 m, but there have been no detailed studies of diving behavior.

Popov and Klishin (1998) recorded auditory brainstem responses from a short-beaked common dolphin. The audiogram was U-shaped with a steeper high-frequency branch. The audiogram bandwidth was up to 128 kHz at a level of 100 dB above the minimum threshold. The minimum thresholds were observed at frequencies of 60 to 70 kHz (Popov and Klishin 1998).

Long-beaked common dolphin, *Delphinus capensis*

Two species of common dolphin occur off California, the more coastal long-beaked dolphin (*D. capensis*) and the more offshore short-beaked dolphin (*D. delphis*). The long-beaked common dolphin is less abundant, and only recently has been recognized as a separate species (Heyning and Perrin 1994). Thus, much of the available information has not differentiated between the two species. The population size is estimated to be 21,902 (CV=0.50) individuals (Barlow and Forney 2007) although the NMFS Stock Assessment Report estimates there are 15,335 (CV=0.56) long-beaked common dolphins in the waters of California (Carretta *et al.* 2007). Long-beaked common dolphins were a strategic stock under the MMPA but that designation was

removed in 2008 (Carretta *et al.* 2008). The numbers of the short-beaked common dolphins have been increasing, likely because of gradual warming of waters off California with the population shifting north (Heyning and Perrin 1994; Barlow *et al.* 1997; Forney 1997), but long-beaked common dolphins have decreased.

This species is an opportunistic feeder of small mesopelagic fishes and squids found in the deep scattering layer. There have been several studies on localized feeding behavior of short-beaked common dolphins, but none specifically on long-beaked common dolphins as they have only been differentiated as a separate species since the late 1990s. There have been no studies on depth distribution of either *Delphinus* species. Most foraging behavior studies (many based on stomach content analysis of stranded animals) indicate that common dolphins take advantage of small schooling fish that undergo vertical migrations at night and that most feeding takes place at dusk and early evening (Pusineri *et al.*, 2007). Perrin (2002b) indicates that common dolphins may forage to depths of 200 m but that most dives occur in less than 100 m.

Northern right whale dolphin, *Lissodelphis borealis*

The northern right whale dolphin occurs in a band across the north Pacific, generally between 34° and 55°N from 145° to 118°W (Lipsky, 2002). They are primarily an open ocean species, with some evidence of movement inshore in winter and spring that is likely related to prey availability. Population size of the California/Oregon/Washington Stock is estimated to be 11,097 (CV=0.26) individuals (Barlow and Forney 2007). The 2008 Stock Assessment Report estimates a population of 12,876 (CV=0.30; Carretta *et al.* 2008).

Peak numbers of northern right whale dolphins are seen in Southern California in December and January. Northern right whale dolphins were dispersed throughout offshore waters in the SCIRC during the cold water months, with several sightings near San Clemente Island. They were rare in the continental slope waters of the SCIRC during the warm-water months (Forney 1997; Carretta *et al.* 2000).

There are no depth distribution data for this species. They feed on small fish, especially lanternfish and squid (Lipsky, 2002), and are believed to take advantage of the deep scattering layer around 200 m. Based on the lack of specific information, spinner dolphin depth distribution data would be extrapolated to northern right whale dolphins. Studies on spinner dolphins in Hawaii have been carried out using active acoustics (fish-finders) (Benoit-Bird and Au, 2003). These studies show an extremely close association between spinner dolphins and their prey (small, mesopelagic fishes). Mean depth of spinner dolphins was always within 10 m of the depth of the highest prey density. These studies have been carried out exclusively at night, as stomach content analysis indicates that spinners feed almost exclusively at night when the deep scattering layer moves toward the surface bringing potential prey into relatively shallower (0-400 m) waters. Prey distribution during the day is estimated at 400-700 m.

There is no published data on the hearing abilities of this species.

Dall's porpoise, *Phocoenoides dalli*

Dall's porpoises are endemic to the north Pacific, ranging north of ~32°N into the Bering Sea. They are generally found in deep, cool waters but are also common in coastal areas, and there is

evidence for inshore-offshore and north-south seasonal movement (Jefferson, 2002). Population size for the Washington/Oregon/California Dall's porpoise stock is estimated to be 85,955 (CV=0.45) individuals with (Barlow and Forney 2007). The NMFS Stock Assessment Report estimates there are 48,376 (CV=0.24) Dall's porpoises in the waters of California, Oregon, and Washington (Carretta *et al.* 2008).

Dall's porpoise is probably the most abundant small cetacean in the North Pacific Ocean. Its abundance changes seasonally, probably in relation to water temperature. It is considered to be a cold-water species, and is rarely seen in areas where water temperatures exceed 17 degrees Celsius (°C) (Leatherwood *et al.* 1982). Its distribution shifts southward and nearshore in autumn, especially near the northern Channel Islands, and northward and offshore in late spring (Dohl *et al.* 1981; Barlow *et al.* 1997; Forney and Barlow 1998). Dall's porpoises are found in the SOCAL Range Complex throughout the year (Forney and Barlow 1998).

Dall's porpoise feed on a wide variety of schooling fish, including herring and anchovies, mesopelagic fish including deep-sea smelts, and squids (Jefferson, 2002). One study of this species includes dive information for a single animal (Hanson and Baird, 1998).

There are no published data on hearing ability of this species.

CARNIVORES - PINNIPEDS

Northern fur seal, *Callorhinus ursinus*

The northern fur seal is endemic to the north Pacific. Breeding sites are located in the Pribilof Islands (up to 70% of the world population) and Bogoslof Island in the Bering Sea, Kuril and Commander Islands in the northwest Pacific, and San Miguel Island in the southern California Bight. Two separate stocks of northern fur seals are recognized within U.S. waters, the Eastern Pacific Stock and the San Miguel Island Stock (Barlow *et al.* 1998). A population estimate for the San Miguel Island Stock is 9,424 (Carretta *et al.* 2008). The San Miguel Island Stock is believed to remain predominantly offshore California year round. The Eastern Pacific Stock of northern fur seal is classified as a strategic stock because it is designated as depleted under the MMPA. The San Miguel Island Stock, which occurs north of the SOCAL Range Complex, is not considered depleted or strategic under the MMPA.

The Eastern Pacific Stock spends May to November in northern waters and at northern breeding colonies. In late November, females and young begin to arrive in offshore waters of California, with some animals moving south into continental shelf and slope waters. Maximum numbers are found in waters from 34°N to 42°N during February to April; most are found offshore of the continental slope. By early June, most seals of the eastern Pacific Stock have migrated back to northern waters (Antonelis and Fiscus 1980). Adult males from the Eastern Pacific Stock generally migrate only as far south as the Gulf of Alaska (Kajimura 1984).

Northern fur seals feed on small fish and squid in deep water and along the shelf break; deep dives occur on the shelf and feeding probably occurs near the bottom (Gentry, 2002). There have been a few studies of this species' diving habits during feeding and migrating, although there is little information on dive depth distribution. Ponganis *et al.* (1992) identified two types

of northern fur seal dives, shallow (<75 m) and deep (>75 m). Diving was deeper in the daytime than during nighttime, perhaps reflecting the different distribution of prey (especially juvenile pollack), and also differed between inner-shelf, mid-shelf, outer-shelf and off-shelf locations. Deeper diving tended to occur on-shelf, with shallower diving off-shelf. Baker (2007) presented results of post-weaning migration of pups from the Pribilof Islands. During pre-migration, pups remained close to their natal islands and dives were mostly shallow (92% of dives to <5 m) and short (89% at <1 min duration). Nearly all diving occurred during daytime hours. Once the pups began migrating, dive patterns changed significantly in that most diving occurred at night. Dives were still relatively shallow (77% of dives to <10m) and short (81% at <1 min duration). The author suggests that the shallow night diving might indicate that the pups were feeding on vertically migrating prey.

The underwater hearing range of the northern fur seal ranges from 0.5 Hz to 40 kHz (Moore and Schusterman 1987; Babushina *et al.* 1991) with best underwater hearing occurring between 4 and 17 to 28 kHz (Moore and Schusterman 1987; Babushina *et al.* 1991). The maximum sensitivity in air is at 3 to 5 kHz (Babushina *et al.* 1991), after which there is an anomalous hearing loss at around 4 or 5 kHz (Moore and Schusterman 1987; Babushina 1999).

Guadalupe fur seal, *Arctocephalus townsendi*

Guadalupe fur seals are listed as threatened under the ESA and therefore, are listed as depleted and a strategic stock under the MMPA. The population is considered a single stock because all are recent descendents from one breeding colony at Isla Guadalupe, Mexico. The state of California lists the Guadalupe fur seal as a fully protected mammal in the Fish and Game Code of California (Chapter 8, Section 4700, d), and it is also listed as a threatened species in the Fish and Game Commission California Code of Regulations (C.F.R.) (Title 14, Section 670.5, b, 6, H). The Guadalupe fur seal is also protected under CITES and fully protected under Mexican law. Guadalupe Island was declared a pinniped sanctuary by the Mexican government in 1975. Critical habitat has not been designated for this species in the United States.

Guadalupe fur seals are the only “southern” fur seal of the genus *Arctocephalus* that occurs in the northern hemisphere (Arnould, 2002). They are distributed from the Channel Islands off southern California to the southern tip of Baja California, Mexico (Reeves *et al.*, 2002). The main breeding colony is on Isla Guadalupe off Baja California (Gallo Reynoso, 1994) with a more recent colony found on Isla Benito del Este, Baja California (Maravilla-Chavez and Lowry, 1999). Guadalupe fur seals have been observed at Channel Island rookeries, and at least one pup was born at San Miguel Island (Melin and DeLong, 1999). The most recent population estimate of Guadalupe fur seals was 7,408 (Carretta *et al.* 2007). Guadalupe fur seals are present in Baja California rookeries from June-August during the breeding season and during the prolonged fall-winter molting season (Gallo-Reynoso, 1994). Females and juveniles may remain near the island rookeries throughout the year, although adult males are generally present in summer only (Gallo-Reynoso, 1994).

Guadalupe fur seals likely feed on a variety of prey, including fish, cephalopods, and crustaceans (Arnould, 2002). Gallo-Reynoso (1994) instrumented one female with a time-depth recorder and analyzed scat. Most dives occurred from dusk to dawn, with mean dive depth 16.8 m and maximum dive depth 82 m. The mean bottom time (1.4 min) represented 54% of the mean dive

duration (2.6 min). Dives occurred in bouts, separated by extended periods at the surface or transiting to other foraging areas. Approximately 14% of time was spent transiting from the island to foraging areas. Analysis of scat showed that fur seals feed on vertically migrating squid found in relatively shallow depths. Additional dive information was obtained by Lander *et al.* (2000) on a rehabilitated fur seal outfitted with a satellite-linked time-depth recorder. During migration north from a release site at Point Piedras Blancas, California, to Isla Guadalupe, mean dive depth was 15.7 m, but the majority of time was spent <4 m; nearly all of the migration time was spent <20 m. Once the seal arrived at Isla Guadalupe, the majority of dives occurred from dusk through dawn. Most dives were shallow (<20 m), and mean dive depth was 13.9 m.

There is no published information on the hearing range of the Guadalupe fur seal although it is most likely similar to other fur seals species. The underwater hearing range of the northern fur seal ranges from 0.5 Hz to 40 kHz (Moore and Schusterman 1987; Babushina *et al.* 1991). The best underwater hearing occurs between 4 and 17 to 28 kHz (Moore and Schusterman 1987; Babushina *et al.* 1991).

Steller sea lion, *Eumetopias jubatus*

The range of the Steller sea lion (SSL) crosses the north Pacific from Japan to northern California (Loughlin, 2002). This species does not undergo extensive migrations but will disperse widely during the non-breeding season. Listed as endangered under the ESA, Steller sea lions are rarely sighted in Southern California waters and have not been documented interacting with Southern California fisheries in over a decade. The last documented interaction with California-based fisheries was in Northern California, in 1994, with the California/Oregon drift gillnet fishery (NMFS 2000). The last sighting of a Steller sea lion (a subadult male) on the Channel Islands was in 1998 (Thorson *et al.* 1999). For the reasons listed above, Steller sea lions are not likely to be present in the action area.

California sea lion, *Zalophus californianus*

The U.S. stock of California sea lion breeds in the Channel Islands in the southern California Bight. Sea lions are found off southern California year round. Pupping and breeding activities commence in May, when males go ashore at rookeries on Santa Barbara, San Clemente, San Miguel and San Nicolas islands to fight for territories; they will remain ashore during the entire breeding season (Heath, 2002). Females begin to come ashore at the rookeries in May and June to give birth to single pups, and soon after begin a cycle of remaining ashore to feed the pup (1-2 days) alternated with lengthy foraging trips at sea (2-3 days). Breeding takes place about 30 days after pupping, although not every female breeds every year. When the breeding season ends in August, adult and subadult males leave the rookeries and head north to northern California, Oregon, Washington, and British Columbia, where they will forage throughout fall and winter (August-April). Females and pups generally remain nearer the Channel Islands year round, remaining on the continental shelf to feed. The California sea lion population estimate for the U.S. Stock is 238,000 (Carretta *et al.* 2008).

There are two additional stocks of California sea lions; one breeds on islands off the west coast of Baja California, while the other breeds on islands in the Gulf of California. There is likely some mixing between the U.S. stock and the Western Baja California stock, although rookeries

are geographically separated so the extent of mixing is unknown. Maldonado *et al.* (1995) reported genetic differences between the U.S. stock and the stock found in Gulf of California, so the degree of mixing between those stocks is likely minimal.

During the breeding season from May-July, most sea lions will be (a) onshore at the rookeries establishing or defending territories (adult males), (b) further north feeding (subadult males), (c) onshore pupping and/or nursing (~one-third of all adult females), or (d) onshore not yet swimming in open ocean (newborn pups). The only California sea lions expected to be in the waters near the rookeries are adult females who either did not pup or who are foraging in-between nursing bouts.

California sea lions feed on a wide variety of prey, including northern anchovy, Pacific whiting, rockfish, mackerel, and cephalopods (Heath, 2002). During El Niño years, sea lions often prey on species that would otherwise not be consumed, and may have to travel farther to feed. There have been limited dive data collected on California sea lions. Feldkamp *et al.* (1989) tagged ten female sea lions on San Miguel Island during the breeding season. The deepest dive recorded was estimated at 274 m but most dives were <80 m (with the majority between 20 and 60 m; see Figure 4 in Feldkamp *et al.*, 1989). Less than 5% of all dives were >200 m. Peak diving frequency occurred near sunrise and sunset, but diving was recorded during all hours. Activity patterns showed that ~33% of total time was spent diving, ~41% was spent swimming between dive bouts, ~23% of the time was at the surface during dive bouts, and 3% was spent resting. Seasonal and diel diving patterns suggested that prey presence strongly influences depth and duration of dives.

The California sea lion has a range of maximal sensitivity underwater between 1 and 28 kHz (Schusterman *et al.* 1972). It shows relatively poor hearing at frequencies below 1,000 Hz (Kastak and Schusterman 1998). The best range of sound detection is from 2 to 16 kHz (Schusterman 1974). Kastak and Schusterman (2002) determined that hearing sensitivity generally worsens with depth—hearing thresholds were lower in shallow water, except at the highest frequency tested (35 kHz), where this trend was reversed. Octave band noise levels of 65 to 70 dB above the animal's threshold produced an average TTS of 4.9 dB in the California sea lion (Kastak *et al.* 1999). Center frequencies were 1,000 Hz for corresponding threshold testing at 1000Hz and 2,000 Hz for threshold testing at 2,000 Hz; the duration of exposure was 20 min.

Northern elephant seal, *Mirounga angustirostris*

The California stock of elephant seals breeds at rookeries located along the California coast and on several of the Channel Islands; breeding season is December through February (Reeves *et al.*, 2002). The most recent population estimate (2001) was 101,000 animals and was based primarily on pup counts (Carretta *et al.*, 2007). A geographically isolated stock of northern elephant seals also breeds on several islands off Baja California (Stewart *et al.*, 1994). The foraging area for the Mexican stock is unknown but is hypothesized to be slightly south of the main foraging area for the California stock (Aurioles *et al.*, 2006). Except during breeding season and annual molt, elephant seals remain largely at-sea foraging and rarely haul out for long periods of time. Adult male elephant seals migrate north via the California current to the Gulf of Alaska during foraging trips, and may be found offshore California in May and August (migrating to and from molting periods) and November and February (migrating to and from

breeding periods), but likely their presence there is transient and short-lived. Adult females and juveniles forage in the California current offshore California to British Columbia (LeBoeuf *et al.*, 1986, 1993, 2000). Females remain on shore with their pups for a few weeks and do not feed during this time. Pups remain onshore for three-six months after birth before they venture offshore (Hindell, 2002). Females and juveniles return to rookeries and haulouts to molt from March through July. Molting takes about three weeks and is a long protracted population event as different age and sex classes tend to molt at the same time.

Northern elephant seals spend little time nearshore, and pass through offshore waters four times a year as they travel to and from breeding/pupping and molting areas on various islands and mainland sites along the Mexico and California coasts. Small colonies of northern elephant seals breed and haul out on Santa Barbara Island with large colonies on San Nicolas and San Miguel Islands (Bonnell and Dailey 1993; DoN 1998; 2002).

During the breeding period (December-February), offshore occurrence would be limited to immature (non-breeding) seals because adult males, females, and pups remain mostly ashore. Following the breeding season, most seals are at-sea foraging, but some juveniles are returning to rookeries to molt. Molting of all age and sex classes occurs over a roughly 15-week period from March-July. In August-November, offshore occurrence would include all elephant seals except adult males, and there is no molting taking place.

Elephant seals feed on deep-water squid and fish, and likely spend about 80% of their annual cycle at sea feeding (Hindell, 2002). There has been a disproportionate amount of research done in the diving capabilities of northern elephant seals for a few reasons. Breeding and molting beaches are all located in California and Baja California, and are fairly easily accessed by researchers. Elephant seals are relatively easy to tag (compared to cetaceans) when they are hauled out on the beach and the tag package can be retrieved when the animal returns to shore rather than relying on finding it in the ocean. They are deep divers, and have been tracked to depths >1000 m, although mean depths are usually around 400-600 m.

The audiogram of the northern elephant seal indicates that this species is well adapted for underwater hearing; sensitivity is best between 3.2 and 45 kHz, with greatest sensitivity at 6.4 kHz and an upper frequency cutoff of approximately 55 kHz (Kastak and Schusterman 1999).

Harbor seal, *Phoca vitulina*

Harbor seals are found largely in coastal areas of the North Pacific and North Atlantic (Reeves *et al.*, 2002). Most are non-migratory, and breed and feed in the same area throughout the year. The current estimate for harbor seals in the California stock is 34,233 (Carretta *et al.*, 2008). Harbor seals are considered abundant throughout most of their range from Baja California to the eastern Aleutian Islands. The SCB is near the southern limit of the harbor seal's range (Bonnell and Dailey 1993). Some harbor seals haul out and breed on Santa Barbara, San Clemente, and Santa Catalina islands within the SOCAL Range Complex, but most harbor seals haul out further north (Lowry *et al.*, 2005). Only three islands are completely or partially within the area of the SOCAL range (San Clemente, Santa Catalina and Santa Barbara) and, due to their non-migratory nature, only harbor seals counted at those islands are included in density calculations.

Studies of harbor seal diving behavior have been conducted in several locations on various age, physiological and sex classes. Harbor seals feed on fish, octopus, squid, shrimp and other available prey (Reeves *et al.*, 2002), and have been observed eating Pacific herring and salmon in Washington inland waters (Suryan and Harvey, 1998). They make mostly U-shaped (or square) dives when foraging, but also V-shaped, “wiggle”, and skewed dives (Baechler *et al.*, 2002), and may spend ~85% of the day diving for food (Reeves *et al.*, 2002). Bowen *et al.* (1999) found that lactating females from Sable Island, Nova Scotia, spent 45% of time on land with their pups, 55% of time at sea and only 9% of the total time actively diving, indicating that there is widespread variation within the species. Bowen *et al.* (1999) also determined that about half of the total dive time was spent at the bottom of the dive. Eguchi and Harvey (2005) found that median depth and duration of dive were positively correlated with body mass, and large adult males generally dove deeper and longer than the smaller adult females. Burns (2002) indicates that they are capable of diving to >500 m. Foraging dive bouts consisting of several rapidly occurring U-shaped dives were separated from one another by equally long bouts of non-foraging dives to <3 m (see Eguchi and Harvey, 2005; Figure 2). Approximately 50% of total time was spent at the surface in non-foraging mode.

The harbor seal hears almost equally well in air and underwater (Kastak and Schusterman 1998). Harbor seals hear at frequencies from 1 to 180 kHz, however best hearing is below 60 kHz with peak hearing sensitivity at 32 kHz in water and 12 kHz in air (Terhune and Turnball 1995; Kastak and Schusterman 1998; Wolski *et al.* 2003). Kastak and Schusterman (1996) observed a TTS of 8 dB at 100 Hz from 6 to 7 hours of intermittent broadband continuous construction noise (sandblasting; 200 to 2000 Hz at 95 to 105 dB SPL unweighted in the seal’s enclosure) per day for six days, with complete recovery approximately one week following exposure. Kastak *et al.* (1999) determined that underwater noise of moderate intensity (65 to 75 dB above the animals hearing threshold at 100, 500 and 1000 Hz) and continuous duration of 20 minutes is sufficient to induce a small TTS of 4.8 dB in harbor seals.

CARNIVORES - MUSTELIDS

Sea Otter, *Enhydra lutris nereis*

The sea otter falls under the regulatory oversight of the U.S. Fish and Wildlife Service (USFWS), while all other species of marine mammals occurring within Southern California fall under the regulatory oversight of NMFS. The southern sea otter is listed as threatened under the ESA and, therefore, considered depleted under the MMPA. If restrictions on the use of gill and trammel nets in areas inhabited by southern sea otters were lifted, the southern sea otter population would be designated as a strategic stock as defined by the MMPA (USFWS, 1995 in Carretta *et al.* 2007). The translocated population at San Nicolas Island (approximately 29 individuals) and those sea otters that migrate south of Point Conception are considered part of an experimental population and therefore are not considered threatened or endangered (USFWS 2008).

Sea otters prefer rocky shorelines with kelp beds and waters about 66 ft (20 m) deep (USFWS 2008). Few sea otters venture beyond 5,200 ft (1,600 m) from shore, and most remain within 1,600 ft (500 m) (Estes and Jameson 1988). They require a high intake of energy to satisfy their metabolic requirements. Most sea otters in California tend to be active at night and rest in the

middle of the day (Ralls and Siniff, 1990), but there is extensive variation in the activity of individuals both among and within age and sex classes (Ralls *et al.* 1995).

Sea otters are rarely sighted in the SOCAL Range Complex. Only a limited number of sea otter sightings have been reported near SCI (only three sightings) (Leatherwood *et al.* 1978). All of those were ~3 mi (5 km) from SCI during the NMFS/SWFSC 1998–1999 surveys (Carretta *et al.* 2000).

Sea otters spend about one-quarter to one-third of their time foraging to meet metabolic needs. They feed on or near the bottom in shallow waters, often in kelp beds. They dive to the bottom to collect crabs, clams, urchins, and mussels, and return to the surface to open and consume prey. Major prey items are benthic invertebrates such as abalones, sea urchins, and rock crabs. Sea otters also eat other types of shellfish, cephalopods, and sluggish near-bottom fishes. The diet varies with the physical and biological characteristics of the habitats in which they live (reviews by Riedman and Estes 1990; Estes and Bodkin 2002). Sea otters exhibit individual differences not only in prey choice, but also in choice and method of tool use, area in which they tend to forage, and water depth (Riedman and Estes 1990; Estes *et al.* 2003b). In rocky-bottom habitats, sea otters generally forage for large-bodied prey offering the greatest caloric reward. In soft bottom habitats, prey is smaller and more difficult to find; sea otters feed on a variety of burrowing invertebrates. Sea otters in California typically forage in waters with a bottom depth less than 82 ft. though individuals have been sighted foraging in waters with a bottom depth as great as 118 ft. (Riedman and Estes 1990; Ralls *et al.* 1995). The record dive depth occurred in the Aleutian Islands, where a sea otter drowned in a king crab pot set at a bottom depth of approximately 328 ft. (Riedman and Estes 1990). Mean dive duration exceeds 125 sec (Ralls *et al.* 1995).

There is no hearing data available for this species (Ketten 1998).

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

This chapter represents the scientific and analytic basis for comparison of the direct, indirect, and cumulative effects of the alternatives. Regulations for implementing the provisions of NEPA require consideration of both the context and intensity of a proposed action (40 CFR Parts 1500-1508). Thus, the significance must be analyzed in several contexts, such as society as a whole, the affected resources and regions, and the affected interests. Intensity refers to the severity of the impact and the following 10 specific aspects that must be considered: (1) beneficial and adverse effects; (2) effects on public health and safety; (3) unique characteristics of the geographic area (*e.g.*, proximity to historic or cultural resources, park lands, and ecologically critical areas); (4) degree to which possible effects are likely to be highly controversial; (5) degree to which possible effects are highly uncertain or involve unique or unknown risks; (6) precedent-setting actions; (7) whether the action is related to other actions with individually insignificant but cumulatively significant impacts; (8) loss or destruction of significant scientific, cultural, or historical resources (including adverse effects on sites listed in the National Register of Historic Places); (9) degree to which action may adversely affect an endangered or threatened species or designated critical habitats; and (10) violation of Federal, state, or local laws imposed for protection of the environment.

NMFS has, through NAO 216-6, established agency procedures for complying with NEPA and the implementing regulations issued by the Council on Environmental Quality. NAO 216-6 specifies that issuance of scientific research permits under the MMPA and ESA is among a category of actions that are generally exempted (categorically excluded) from further environmental review, except under extraordinary circumstances. Specifically, when a proposed action that would otherwise be categorically excluded is the subject of public controversy based on potential environmental consequences, has uncertain environmental impacts or unknown risks, establishes a precedent or decision in principle about future proposals, may result in cumulatively significant impacts, or may have an adverse effect upon endangered or threatened species or their habitats, preparation of an EA or EIS is required.

Issuance of a scientific research permit under the MMPA and ESA authorizes “takes” of marine mammals and threatened or endangered species, respectively. Given the definitions of take, harassment, and harm under the MMPA and ESA, a “take” as authorized under a permit issued pursuant to the MMPA or ESA could be considered an “adverse effect” on the affected individual animal. However, adverse impacts on individuals of an ESA listed species may not rise to the level of adverse effect upon the species, particularly if the effects are constrained to a small number of individuals relative to the population size, are short-term, transitory, recoverable, or otherwise do not interfere with population level parameters such as survival and reproductive capacity.

In the case of the proposed action, the most likely avenue for “take” is via Level B harassment related to short-term disruption of behavioral patterns. In fact, the purpose of the proposed research program is to scientifically determine the conditions under which various kinds of sound exposure cause short-term changes in behavior in focal marine mammals, in order to better predict and minimize when such effects (and/or more severe ones) may occur as a function

of human activities (such as military sonar training operations). Since the proposed action would occur within the range of various marine mammal species, some individual marine mammals may be “taken” through harassment. However, it should be noted that an adverse effect upon an individual animal does not necessarily equate to an adverse effect upon the entire species to which that animal belongs. Since NEPA does not define what an adverse effect on a threatened or endangered species is, NMFS will rely upon the following to examine the degree to which a proposed action would result in adverse effects on a listed species.

An adverse effect on an individual marine mammal does not necessarily translate into an adverse effect on the population or the environment. In order for an adverse effect on an individual member or some number of individuals of a species to result in an adverse effect on the species as a whole, the effects on the individuals must result in reduced reproduction or survival of the individual that would consequently result in an appreciable reduction in the likelihood of survival or recovery for the species. Therefore, in order for the proposed action to have an adverse effect on a species, the exposure of individual animals of a given species to the sound source would first have to result in the disruption of essential behaviors of the exposed individual, such as feeding, mating, or nursing, to a degree that the individual’s likelihood of successful reproduction or survival was substantially reduced. Second, the substantial reduction in the individual’s likelihood of successful reproduction or survival would have to result in a net reduction in the number of individuals of its species. In other words, the loss of the individual or its future offspring would not be offset by the addition, through birth or emigration, of other individuals into the population. Third, that net loss to the species would have to be reasonably expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild. The effects of the proposed action on threatened and endangered species are further evaluated through the interagency consultation process pursuant to Section 7 of the ESA, as described in Subchapter 4.4.

Whether or not a marine animal may be affected by the proposed action is dependent on two factors. The first factor is presence. Some animals are only in the action area at certain times of the year, others may only be present at certain times of day. The second factor is detection of the sounds produced by the source. Whether or not an animal can detect (hear) the sound is dependent on, among other things, the amplitude level (perceived as “loudness”) and sound frequency (or “pitch”). The auditory (hearing) threshold is defined as the amplitude level required for detection at a given sound frequency; in other words, auditory threshold is a measurement of the weakest sound of a given frequency that an individual can detect. As an example, humans are capable of hearing 32 kHz sounds, but only when they are extraordinarily loud because our ears are not nearly as sensitive at detecting sounds in this frequency range compared to lower frequencies.

For those marine animals that are both present and can detect the sounds, whether or not they would be adversely affected is a function of their exposure as well as their physiological and/or behavioral response. Exposure at the animal is a function of the frequency and energy level of the source, the animal’s proximity to the source, duration of exposure, and the physical features of the environment in which the exposure occurs. For a given species, its response is likely to be a function of a variety of biological factors. For example, whether or not an animal that hears the sound deviates from its course or otherwise alters its behavior could depend on its age, sex,

reproductive condition, the time of year or day, the behavior of other animals in its vicinity, the specific behavior in which it was engaged at the time of exposure, its previous exposure history with the same or similar sounds, or some combination of the above.

At any given distance from the source, only those marine animals with sufficient hearing sensitivity at the received sound level and in the frequency range of the sound source would be “exposed” during the proposed research. Available information on the hearing sensitivity of invertebrates, sea turtles, sea birds, and most fish (as summarized in Chapter 3) suggests they are not likely to be “exposed” at any time during the proposed action. For focal marine mammal species within the action area, “exposure” would be up to a maximum received level of 180 dB re: 1 μ Pa (hereafter sound pressure level, or SPL). The sound sources to be used would have a lower source level than other common sound sources such as military active sonar systems. Additionally, very specific monitoring procedures of the area and shutdown protocols for exposures would be in place during the experiments. Subsequently, estimates of incidental harassment takes are still likely over-estimated.

As discussed in Subchapter 1.2, NMFS has previously prepared EAs on active acoustics research permits because of “public controversy” (*i.e.*, AUTECH BRS EA; NMFS 2007) or uncertain environmental impacts (*i.e.*, Tyack EA; NMFS 2003). Virtually any activity involving acoustics and marine mammals has been perceived by some members of the public as “controversial,” including the use of intentional introduction of sound through research sound sources, sonars, and airguns for oil and gas exploration. The purpose of this proposed research, though, is to define how marine mammals (including possibly quite sensitive species such as beaked whales) respond to specific known exposure levels of sonar and other sounds. This information would be used to assess and predict the acoustic exposure conditions of mid-frequency (MF) sonar sounds that elicit an identifiable behavioral indicator response in targeted marine mammals, so that sound producers and regulatory agencies can better understand, minimize, and manage noise impacts on protected species.

Based on the proposed mitigation measures, and previous successful research using similar methods (principally the BRS study in the Bahamas recently) exposures would be controlled to ensure the safest possible method of exposure. The knowledge gained from the proposed action would facilitate the formulation or modification of regulations for improving the protection of ESA or MMPA species from noise exposure, as well as public awareness and understanding of these issues through targeted communication of results. This would aid the permitting and regulatory process by increasing the ability to predict and minimize future marine mammal biologically significant behavioral incidents.

4.1 Effects of Alternative 1 – No Action

Under this alternative, the “no action” alternative, a new permit for scientific research to conduct a behavioral response study on deep diving odontocetes would not be issued at this time.

Although the action area for the proposed study encompasses a relatively small portion of ocean, the behavioral response study, if proven reliable, could have a much wider geographic application. Increasing evidence suggests the potential for beaked whales to strand when exposed to intense underwater sounds in some settings, and that some of the stranded animals

may die (Simmonds and Lopez-Jurado, 1991; Frantzis, 1998, Cox *et al.* 2006). Some reports on this problem correlate the strandings with military sonars at source levels exceeding 226 dB SPL that are operated intermittently for many hours in the mid frequency band (SACLANTCEN, 1998; DOC and SECNAV, 2001). The dominant species in these strandings is Cuvier's beaked whale, *Ziphius cavirostris*, but the genus *Mesoplodon* is also involved. Thus, most marine mammal strandings that have been coincident with MF sonar exercises have involved beaked whales. Until the causes of these strandings can be identified, (and possibly dose:response relationships defined) it will remain difficult to discriminate an actual hazard from random coincidences of human activities and natural strandings. One of the most direct and precise ways to test whether MF sonar sounds could pose a risk of stranding is to conduct a combination of observational studies and carefully controlled experiments to determine safe and early indicators of responses that may be linked to a causal chain of events leading to stranding.

The existing baseline condition is that the ocean in general is a very noisy place, from both natural and human activities and particularly in developed coastal regions like that of the action area. Under the "No Action" alternative, there would be no additional noise contribution from intentional playbacks using the BRS sound source. However, if the BRS study were not conducted, scientific information that could be used by NMFS for the formulation of protective regulations would not be collected. Also, there would be no collection of empirical data on the behavioral effects of these sounds on marine mammals, particularly deep diving odontocetes, and on possible causes for strandings.

4.2 Effects of Alternative 2 – Proposed Action

Under the Proposed Action alternative, a five-year scientific research permit would be issued to NMFS Office of Science and Technology authorizing takes of marine mammals by harassment during exposure to the sound sources and by close approaches for photo-identification, attachment of scientific instruments, and behavioral observations. Visual and passive acoustic monitoring would be implemented to ensure there would be no Level A harassment takes of marine mammals from the playbacks; and there would be clear source shutdown criteria to limit exposure to Level B harassment. Sloughed skin samples from detached tags would be collected for analysis.

Under the Proposed Action alternative, a permit would authorize the intentional exposure of target marine mammals to controlled coherent/incoherent sound source transmissions. A permit would also authorize unintentional exposure of a number of other marine mammals under NMFS jurisdiction to the source, as outlined in Table 2-5.

The proposed initial Phase I BRS field research activity is planned for a period of approximately 8 weeks in the late summer/fall of 2010. Based upon their direct experience tagging beaked and pilot whales with archival acoustic tags in many places and contexts, the permit applicant assumes a 20 percent success rate (# successful attachments/touch) for attachment to beaked whales and 40 percent for pilot whales. Beaked whales are not just difficult to tag, but they are also quite difficult to sight and approach. Based upon previously conducted fieldwork, the applicant estimates four CAs are required for one chance to touch an animal with a tag. During previous fieldwork with *Ziphius* in the Ligurian Sea, researchers listed in the permit application followed groups of up to 7 individuals. However, animals are often sighted alone. For this BRS,

the permit applicant assumed the nominal group sizes as listed in Table 3-2. On average, a CA to a beaked whale for tag attachment may actually involve CA to two or more whales in addition to the tagging subject.

The sensitivity and responsiveness of animals is likely to vary within a population. This means that it is essential to conduct playbacks (PBs) to a sample of animals. On the other hand, there is a limit to the number of animals that can be tagged and followed within an 8-week experiment. For most of the species to be studied by tagging individuals for PBs, the permit applicant hopes for a sample size of 20 focal tagged individuals for this Phase I (BRS).

The permit applicant proposes to conduct initial PBs with beaked whales (the primary target species), such that maximum RL at the subject is no greater than the levels associated with behavioral responses that could be considered meaningful to the animal but are not likely to have serious negative consequences unless repeated or sustained for a long period (e.g., cessation of foraging activity and/or movement away from the source). In initial observational work with beaked whales would occur with the source at sufficient range from the animal such that any potential behavioral reaction by the animal would not be caused by detecting any aspect of the source other than the playback acoustic stimulus. That is, researchers would attempt to remove the potential for contextual response by the animal so as to focus on behavioral reactions caused solely by its response to the sound source to which it is exposed. Researchers would continue to increase the RL until an identifiable behavioral reaction was observed. Thereupon, the exposure would be maintained for an interval of time sufficient to define the response in terms of diving and surfacing behavior. Only after careful study of the identifiable behavioral reaction would researchers propose increasing exposure levels above those required to induce the onset of behavioral responses. The maximum RL researchers would expose any animal to would be 180 dB SPL for underwater MF coherent sounds. NMFS (2003a) currently suggests an exposure above 160 dB SPL in order to estimate MMPA Level B harassment takes.

Most of the potential PB subjects are social and are likely to be sighted in groups. Researchers would obtain as much data as possible from other animals within the group, but the primary unit for statistical analysis would remain the PB of a specific stimulus type to focal subjects that have been tagged or are being followed by a small observation vessel (e.g., McGregor, 1992). As was discussed previously, the number of animals exposed to a PB would be estimated by counting all animals within the group of the focal animal as exposed. The assumed nominal group sizes for each of the target species are provided in Table 3-2. These are conservative estimates, given that the PB protocols are designed to minimize the chances that non-focal animals would be exposed to higher levels than the focal individual(s), even if the focal animal is exposed to a level that evokes behavioral reaction, the potential is very low that this many other animals in the area would have exposures that are as high.

Estimating the number of intentional PB takes to proposed target species and unintentional (incidental) PB takes for other species requires estimating the number of PB events. This is complicated by the ability to tag multiple animals simultaneously. Nevertheless, researchers listed in the permit application have succeeded in doing this for both beaked and sperm whales. However, responses of several animals to the same exposure may not be statistically independent. Therefore, for this experiment the permit applicant assumed only one animal

subject per PB, so that a goal sample size of 20 animal PB subjects could be achieved by conducting 20 PBs.

For unintentional (incidental) PB takes, the permit applicant used the same group sizes for as those estimated above. For the incidental takes of other marine mammals, the permit applicant used reasonable estimates of animal distribution, abundance, and density data, coupled with number of PBs. Both sets of the numbers, derived using 220 dB SPL, 5 km/hr relative speed of animal and PB vessel, and 12 hr duration of PB, are presented in Table 2-5. For the Phase I 2009 research, the permit applicant has erred on the conservative side with this calculation methodology.

The entire exposure period is expected to last up to 1-4 hr (although the applicant's calculations assume 12 hr to maximize the conservative estimations of the BRS); subsequent modification of the protocols and increases in the acoustic tag attachment period may increase this exposure period. The experiments are designed to be able to detect identifiable behavioral reactions during this exposure, and to monitor return of behavior to baseline after the exposure stops. Over a series of PB events, the following nominal beaked whale (primary target species) PB sequence is proposed:

- Monitor at least one pre-exposure dive + surface sequence;
- After animal starts next foraging dive, commence PB signals soon after animal starts clicking (average vocal time 26 min);
- Begin with exposure at very low level (e.g., target received levels to be at or near ambient background levels), and slowly ramp up over 10-20 min until identifiable behavioral reaction is elicited or maximum exposure level of 180 dB SPL is attained;
- If animal ceases clicking during PB, maintain exposure level to ascertain if/when clicking resumes;
- If animal ceases clicking during PB and some other identifiable behavioral reaction is noted during the dive + surface sequence, monitor at least one post-exposure dive + surface sequence to ensure return to baseline behavior;
- If an animal ceases clicking during PB and there are no other identifiable behavioral reactions noted during the dive + surface sequence, on the next dive, continue the exposure through cessation of clicking and into the ascent and surface interval;
- If an identifiable behavioral reaction is detected that does not return to baseline within the post-exposure monitoring period, PBs would be temporarily suspended to re-evaluate research protocols;
- After ~10 min (nominally) of PB at the maximum source level (given no contra-indicators), terminate source transmissions;
- If animal did not cease clicking, execute an additional PB on subsequent dives;
- Goal is to elicit identifiable behavioral reaction from underwater MF coherent sound exposure—if no identifiable behavioral reaction after 5 full PBs, most probable option would be to move to another stimulus signal.

It is unlikely, given the design, that individual animals involved in the experiments would have their activities disrupted by more than a few hours. These experiments are designed to evaluate unknown risks of relatively uncontrolled MF sonar exposure, but the careful controls built into the BRS experimental design would minimize the risks of the controlled sound exposures. The

tagging and PB experiments use standard experimental techniques that have been used safely with many species over the past decade under NMFS Scientific Research Permits. Given the large scale and complexity/difficulty of these studies, the proposed combination of close approach, focal follow, tagging and PB is not likely to be adopted by many other researchers.

The most likely effect of the source sounds on marine mammals is temporary avoidance of the exposure area (see Southall *et al.*, 2007). Some behavioral indicators of disturbance, or “Level B” harassment, are avoidance (moving away from the sound), increased vigilance, cessation of an activity, or changes in swim speed or surfacing interval. Avoidance reactions are the most obvious indicators of disturbance, although lack of easily visible responses is not necessarily indicative of a lack of physiological and/or subtle behavioral responses. Avoidance reactions can be strong or mild and can have varying effects on individuals. For example, migrating gray whales were observed to alter their course by 30 deg as they approached an industrial sound source, which allowed them to pass well to the side of the source without making a large change in their course or the length of their migration (Malme *et al.*, 1983, 1984). In addition to avoidance reactions, marine mammals may respond to underwater sounds by changing their activity. For example, cetaceans that are resting or socializing at the surface may dive or start to travel slowly at the onset of man-made noise.

The proposed mitigation measures would minimize exposure of animals to sounds louder than is required to elicit indicator responses in the range of received levels (RL) of interest. The primary features the scientific research team would control in the BRS experiments are the sound type, source level (and thus RL of exposure at the test subject), and (as possible) directionality of the sound source; they would also model and measure sound propagation in order to most precisely predict and control exposure at the animal. The RL at the whale would be increased either by increasing the SL or by having the PB vessel approach or avoid the subject animal(s).

4.2.1 Effects of Tagging

The tagging of animals may evoke short-term behavioral responses such as sudden movement, turning or rolling. The longest effect of tagging that has been detected comes from tagging sperm whales that are breathing at the surface following a foraging dive. Once a tag has been attached to a sperm whale, it may stop its blow sequence and dive earlier than it would otherwise have done. The subsequent foraging dive involves normal diving, foraging, and vocalization behavior, but may be somewhat shorter than the previous or following dives, when the animal blows at the surface for as long as it wants. This change in dive duration does not appear to have an effect beyond an hour, and appears to have minimal effect on foraging. The tag is able to monitor for other reactions. None have been defined in previous tests, other than possible orienting responses (Malakoff, 2001), and the permit applicant does not anticipate any effects on individual animals beyond this kind of short orienting response.

As previously mentioned, the entire exposure series is designed to last up to 1-4 hr (although the applicant’s calculations assume 12 hr to maximize the conservative estimations of the BRS). The experiments are designed to be able to detect identifiable behavioral reactions during this exposure, and to monitor return of behavior to baseline after the exposure stops. It cannot be assumed that an animal will surface after a dive at or near the vicinity of where it commenced the dive, but the SCORE range monitors can usually help vector the PB support vessels to the

vicinity of the animal's surfacing location. If reactions are detected that do not return to baseline within the post-playback tagging duration, then they would suspend PBs and reevaluate the design. Thus, it is unlikely, given the design, that individual animals involved in the experiments would have their activities disrupted by more than a few hours. These experiments are designed to evaluate unknown risks of uncontrolled sound exposure, but the careful controls built into the experimental design would minimize the risks of the controlled sound exposures. The tagging and PB experiments would use standard experimental techniques that have been used safely with many species over the past decade under NMFS Scientific Research Permits.

4.2.2 Effects of Incidental Harassment

It is possible that CAs of one animal for tagging might affect the behavior of other animals nearby. In previous tagging experience, researchers have seen few responses other than animals in the same group as the tagged one following the tagged animal if it turns or dives after tagging. The permit applicant does not anticipate reactions lasting more than a minute to these incidental approaches. Similarly, when researchers conduct a FF with a tagged whale, the FF vessel would also follow other animals nearby. The protocols for FF are designed so that the FF vessel has no effect on the behavior of either the focal animal or its companions, so no harassment is anticipated from this activity.

The primary activity that might cause incidental harassment involves the PB experiments. These experiments are designed so that the FF animal would eventually be exposed to a higher RL than other animals that may be present. However, it is possible that other animals might come close enough to exhibit disruption of behavior. Not every species has been studied with the signals proposed for the PBs, but enough is known to make some predictions. Captive bottlenose dolphins do not show aversive reactions to 1-sec tonal signals until they are above 180 dB SPL (Schlundt *et al.* 2000). Rendell and Gordon (1999) recorded pilot whales in the presence of 0.17 sec pings from a 4-5 kHz sonar. The pilot whales vocalized more often during transmissions, but did not avoid the area during several hours of exposure. Humpback, fin, and right whales have been reported to respond to sonar sounds in the 15 Hz – 28 kHz range (Watkins, 1986), and Maybaum (1993) reports that humpback whales responded to pings from a 3.3 kHz sonar by swimming away with increased speed and linearity (i.e., in a straight line), but the sounds did not consistently affect vocalizations or diving behavior.

The responses of both target and non-target marine mammals to underwater MF coherent sounds would be monitored by visual observers who are on watch before, during and after transmissions while the animals are on the surface. Additionally, passive acoustic monitoring would be used when operating on the SCORE range to monitor the location and vocal behavior of beaked whales, along with any underwater MF coherent sound transmissions on the SCORE range. Beaked whale detections can usually be associated with a RL of the underwater MF sound, if present. The vocal and movement behavior of the beaked whales can be compared in exposure and control conditions, and the acoustic exposure associated with changes in vocal behavior can be quantified. This would help estimate the potential for incidental harassment at this site.

The permit applicant requests takes under the Phase I (BRS) SRP application by incidental harassment for any of the species that may be present in the SOCAL Range Complex where PBs are proposed. Visual and acoustic monitoring would be used to document any incidental

disturbance reactions. Transmissions would be suspended, however, if any marine mammals are detected to have the potential to approach within the 180 dB SPL isopleth for underwater MF coherent sounds, which is conservatively estimated as 200m from the source at the maximum source level.

4.2.3 Effects on Stocks

Based on the Bahamas BRS project and other similar research, the proposed research is expected to have only minor short-term effects on the individual subjects. The PB experiments would only be detectable over a small portion of the seasonal range of the species present in the study area. Therefore, the proposed research would have little direct impact on the relevant species or stock. Since most of these species have been exposed to underwater coherent sounds, any information verifying safe exposure levels will be critical for ensuring adequate protection of these stocks from impacts of human-made noise. If the proposed carefully controlled sound exposures indicate behavioral responses consistent with known sound exposures, the data will be critical in informing regulatory decision-making

4.2.4 Effects from Stress, Pain, and Suffering

This project is designed to minimize to a negligible level the potential of any stress, pain, or suffering. The tags are non-invasive, using soft suction cups, and there is no indication that they cause any pain. An animal can easily dislodge the tag with rolling or shaking movements. A minority does this, usually within a few minutes of tagging. The ease and speed with which they can remove the tag, indicates little chance for stress from attachments. Regarding effects of playbacks, in humans, the threshold for pain from acoustic exposure is above the level that can cause hearing damage. This project is designed not to expose any animals to sound levels high enough to cause either temporary or permanent hearing damage (e.g., TTS, PTS). Animals can avoid exposure during the PB experiments by swimming away, and if any such avoidance reactions are observed, subsequent exposures would be carefully designed to take this into account. Stress from playbacks could possibly involve playback of vocalizations of predator species (e.g., orca calls [Yurk *et al.*, 2002]) for all subject species. If the subject reacts to the playback as if it were a predator, it may experience some stress as it prepares for an anti-predator response. However, these natural sound playbacks are important for understanding whether marine mammals may respond to any anthropogenic signals in a similar way to these natural sounds. Each CA for tagging only lasts a few minutes, and researchers would not approach any individual more than three times a day. The FF and acoustic exposures are designed to last a maximum of several hours, so are unlikely to have any longer term impacts. The PB subjects would be followed after exposure to monitor for return to baseline behavior, and the scientific research team would modify the PB protocol if there is any evidence of longer term changes.

4.2.5 Necessary vs. unnecessary disturbance

The proposed research would use a variety of archival acoustic tags that, while attached, continuously monitor the behavior of the tagged animal. This technique requires CA for photo-identification and for tag attachment, and these CAs and tag attachments may require some brief and necessary disturbance, but the tagging reduces the potential for disturbance during the subsequent FF. FFs of tagged animals can be conducted farther from the subject animal than

would otherwise be required to monitor the behavior of untagged animals. The goal of the FFs is to operate the OV in such a way that it has no effect on the subjects.

The PB studies are designed to determine what kinds of sound exposure may cause behavioral responses in marine mammals that are safe but reliable indicator of responses that may pose a risk of stranding for much longer and/or more intense exposures. Marine mammals are exposed to an increasing number of loud underwater sound sources. One of the primary obstacles to minimizing the risk of adverse impacts of these exposures involves lack of scientific evidence regarding sound levels that may cause disturbance. One objective for the proposed research is to develop a safe indicator response that could be used to inform policy-makers as they put in place regulations to protect these species. The researchers would therefore intentionally expose animals to underwater MF coherent sound in order to test whether the exposure stimulates the indicator response.

All of this field research takes place in a broader policy context, in which interest and concern may focus on specific exposure ranges for specific taxonomic groups and for specific sound sources. As mentioned above, the U.S. Marine Mammal Commission strongly urged setting the upper threshold for exposures up to the level treated by policymakers as likely to disturb. If disturbance is detected and verified at levels below this, the series of PB experiments would document the level at which disturbance starts and would not have to continue sequences to greater exposure levels. Conversely, the appropriate maximum level for PBs may need to go higher in future research studies if no disturbance is detected within the regulated range, assuming that there is minimal potential for physiological effects, or permanent effects on hearing. However, for the Phase I SRP application, the permit applicant proposes to not expose animals to levels above those considered not likely to cause direct physical injury by regulatory agencies (in this case, 180 dB SPL); as noted, current scientific evidence suggests the thresholds for direct physical injury from sound exposure are in fact much higher (Southall *et al.*, 2007).

4.3 Comparison of Alternatives

As mentioned previously, the existing baseline condition is that the ocean in general is a very noisy place, particularly developed coastal regions like that of the BRS action area. Under the Proposed Action alternative, there would be a relatively small increase to the baseline anthropogenic noise from the BRS sound source. Compared to the baseline noise level or harassment of marine mammals of the No Action alternative, this does not represent a substantial increase in exposure to noise or by MMPA Level B harassment from tagging for any marine mammals in the BRS action area. The duration of any exposure would be relatively brief and behavioral responses to detection of the source sounds would be short-lived. The potential for adverse impacts on the human environment is not greater under the Proposed Action compared to the No Action alternative.

4.4 Summary of Compliance with Applicable Laws

As summarized below, issuance of a permit under the action alternative is consistent with the applicable permit requirements of the MMPA, ESA, and NMFS regulations for permit conditions and restrictions. Details of compliance with the MMPA, ESA, AWA, and MSA are provided below.

4.4.1 Marine Mammal Protection Act

In compliance with the requirements of the MMPA, the permit application was made available for public review and comment, and provided to the Marine Mammal Commission. Comments received on the application will be considered by the Office Director in making a determination about permit issuance.

Under the action alternative, a permit would contain standard terms and conditions stipulated in the MMPA and NMFS's regulations. As required by the MMPA, the permit would specify: (1) the effective date of the permit; (2) the number and kinds (species and stock) of marine mammals that may be taken; (3) the location and manner in which they may be taken; and (4) other terms and conditions deemed appropriate. Other terms and conditions deemed appropriate relate to minimizing potential adverse impacts of specific activities (e.g. capture, sampling, etc.), coordination among permit holders to reduce unnecessary duplication and harassment, monitoring of impacts of research, and reporting to ensure permit compliance.

4.4.2 Endangered Species Act

This section summarizes conclusions of the biological opinion resulting from formal consultation to ensure that these proposed permit is not likely to jeopardize the continued existence of any species listed as threatened or endangered or result in the destruction or adverse modification of critical habitat that has been designated for these species as required by section 7(a)(2) of the ESA.

Formal consultation with NMFS Endangered Species Division was initiated for alternative 2, which includes permission to harass threatened and endangered marine mammals of several species. The initiation request identified the following species as likely to be adversely affected by issuance of the permit based on preliminary information about abundance, distribution, and hearing abilities:

- Sperm whale (*Physeter macrocephalus*) – endangered
- Humpback whale (*Megaptera novaeangliae*) – endangered
- Sei whale (*Balaenoptera borealis*) – endangered
- Fin whale (*B. physalus*) – endangered
- Blue whale (*B. musculus*) – endangered
- Guadalupe fur seal (*Arctocephalus townsendi*) – threatened

In its Biological Opinion, NMFS concluded that issuance of the proposed permit is not likely to jeopardize the continued existence of endangered sperm, humpback, sei, fin, or blue whales, or threatened Guadalupe fur seals.

The Biological Opinion contained conservation recommendations, which are discretionary agency actions to minimize or avoid adverse effects of a proposed action on listed species or critical habitat to help implement recovery plans or to develop information for conservation.

The following conservation recommendations were made, which are intended to reduce harassment related to authorized activities and to provide information for future consultations involving issuance of marine mammal permits that may affect endangered whales:

- Cumulative impact analysis. The NMFS Permits Division should work with the Marine Mammal Commission, the International Whaling Commission, and the marine mammal research community to identify a research program with sufficient scope and depth to determine cumulative impacts of existing levels of research on marine mammals, including sub-lethal and behavioral impacts.
- Estimation of actual levels of “take.” NMFS Permits Division should continue to review annual and final reports submitted by marine mammal research permit holders, and data and results that can be obtained from permit holders. This data should be used to estimate the amount of harassment that occurs given the level of research effort, and how the harassment affects the life history of individual animals. The results of this study should be provided to NMFS Endangered Species Division for use in future consultations.
- Assessment of permit conditions. NMFS Permits Division should periodically assess the effectiveness of its permit conditions, including those for notification and coordination of research.
- Data sharing. NMFS Permits Division should encourage investigators to coordinate their efforts by sharing research vessels and the data they collect as a way of reducing duplication of effort and the level of harassment that threatened and endangered species experience as a result of field investigations.

With the exception of the data sharing recommendation, these conservation recommendations pertain to future permits and consultations and do not specify considerations or measures that should be part of the decision on this permit. Under the action alternative, a permit would require that researchers coordinate to the maximum extent practicable, with the intent of minimizing duplication and harassment. This is a standard condition for permits for research on marine mammals. The other conservation recommendations will be taken under advisement for future permit and consultation considerations.

As required under section 10(d), a permit for takes of endangered sperm, humpback, sei, fin and blue whales and threatened Guadalupe fur seals as described in Alternative 2 would not be issued unless NMFS finds that the permit was applied for in good faith, if granted and exercised would not operate to the disadvantage of endangered species, and will be consistent with the purposes and policy set forth in section 2 of the ESA. These findings, to be made by the Director of NMFS Office of Protected Resources, will be based on available information including the analysis in this EA, the Biological Opinion, and other pertinent information. As required by the ESA, these findings would be published in the *Federal Register*.

4.4.3 Animal Welfare Act

Researchers must comply with the humane handling, care, and treatment provisions of the AWA. The applicant does not have an established Animal Care and Use Committee (ACUC) to evaluate compliance of the research protocols for consistency with these provisions of the AWA. However, NMFS has established an “ACUC Task Force” to evaluate how to ensure that its

research on marine mammals is in compliance with the AWA. The Task Force has developed a draft policy for the establishment of ACUCs to cover Science Center activities. Once a final policy is adopted by NMFS, research and grant proposals from the Science Centers will be reviewed by ACUCs for compliance with AWA. The applicant has requested review of their protocols by the Southwest Fisheries Science Center's ACUC, because the research would occur within California.

4.4.4 Magnuson-Stevens Fishery Conservation and Management Act

No adverse effects on essential fish habitat are expected under either action alternative, thus no consultation was warranted.

4.5 Mitigation Measures

There are no additional mitigation measures beyond those conditions that would be required by permit or described in the applicant's protocols. The statutory and regulatory conditions that would be required if a permit were issued are outlined in Appendix A, including monitoring, coordination, and reporting requirements. The permit would also contain conditions specific to the type of research proposed. These conditions are intended to minimize unavoidable adverse effects of the various research activities on target and non-target animals. Mitigation measures proposed by the applicant are summarized in Sections 4.5.1. through 4.5.3.

The permit conditions require regular reports on the effectiveness of the research at achieving the applicant's stated objectives (and thus at achieving the purpose and need of the federal action) and on the effectiveness of the mitigation measures required by the permit. By statute, regulation, and permit conditions, NMFS has authority to modify the permit or suspend the research if information suggests it is having a greater than anticipated adverse impact on target species or the environment.

4.5.1 Measures to Minimize Effects

The basic goal of the PBs covered in the permit application is to determine the lowest exposure of transient transmissions of underwater sound that predictably elicit selected indicator responses from subjects. The studies are designed in such a way as to minimize exposure of animals to sounds louder than is required to elicit identifiable behavioral reactions in this range of RLs. The primary features controlled in the experiments are the sound type, exposure context, and the RL of sound at the test subject, and the scientific research team would model and measure underwater sound propagation to predict and control exposure at the animal. Researchers would start each PB sequence with a SL yielding a relatively low RL at the indicator animal; e.g., a level at or near the ambient background level. After monitoring for potential disturbance, the RL would be increased in a ramp-up procedure to the target exposure level. The RL at the animal would be controlled either by adjusting the SL or by having the PB vessel move relative to the subject.

Researchers would only increase the exposure after determining whether there is a change in behavior at the lower level. The design of these studies, to test whether specific acoustic exposures cause behavioral disruption, does not necessarily mean that they must continue

increasing exposure until they detect significant disturbance of a biologically important behavior. Even if they have not detected such a response, researchers would limit exposure to levels below those thought to pose a risk of injury. As discussed in the following subsection, the maximum RL at the focal animal proposed for the Phase I PBs is 180 dB SPL.

The permit applicant plans playbacks to last on the order of 1-4 hours to test whether normal behavior may soon resume, even during exposure, and they plan to follow post-exposure behavior carefully to monitor the time duration it may take to return to baseline behavior. In the past few years, researchers have increasingly succeeded with 16 hr tag attachments, a duration that would allow for a 4 hour pre-exposure period, 4+ hour exposure and 4 hours post-exposure. The time devoted to the period for each RL must be a compromise between giving the animal time to exhibit an identifiable behavioral reaction and for researchers to detect it, while allowing the PB sequence, which would typically last 1-4 hours, to complete the range of exposures up to the RL goal should no response be observed.

Acoustic monitors using the large underwater array at the SCORE range would also be used to follow the location of vocal intervals of marine mammal groups on the range in real time. Any time that underwater MF coherent sound sources are transmitting on the range, they would record the RLs on bottom-mounted hydrophones near the animals. These measurements would be compared during the course of the PB by RLs measured by any recording tags that have been put in place on the subject animal. The movement and vocal behavior of animals exposed to underwater MF coherent sound sources would be compared to silent control conditions, and this comparison would be used to help establish minimum exposures associated with detectable reactions, and also with typical high levels of exposure not associated with risk. This would minimize the potential of any unexpected effects of experimental exposures during PBs on the SCORE range.

4.5.2 Maximum received level for controlled exposures of noise

The plan for the PB experiments is to determine behavioral responses of marine mammals exposed to received sound levels well below those thought to pose a potential for injury (see Southall *et al.*, 2007). The range of sound exposures has been selected to include those that are currently viewed by regulatory policy as unlikely to pose an adverse impact. The PB research is designed to test these assumptions.

The most important criterion for selection of a maximum exposure level involves the concern not to expose animals to sounds that might cause physiological harm or injury. The permit applicant recognizes that there may be some circumstances where animals would remain in areas with no obvious sign of behavioral disruption, even though the sound exposure may affect their hearing. Therefore, one cannot always rely upon wild animals to swim away from a source to avoid potentially harmful exposures.

Over the past few years, several successful experiments have defined sound exposures that cause TTS in captive dolphins and seals (Ridgway *et al.*, 1997; Kastak *et al.*, 1999; Schlundt *et al.*, 2000) using SEL as the criterion for evaluating exposure in terms of auditory injury. One important feature used to help set this level involves the duration and duty cycle of the signals. For exposure to brief impulses from underwater short coherent sounds with low duty cycles of

the sort to be tested in these studies, the TTS studies suggest that a maximum SEL of 190 dB is conservative. Ridgway *et al.* (1997) and Schlundt *et al.* (2000) found no sign of TTS in dolphins exposed to RLs of single 1-sec signals above 190 dB SEL for sounds at frequencies of best hearing for the dolphins that were longer in duration and narrower in bandwidth. The onset of TTS started at received levels above 190 dB SEL for these sounds lasting one second.

For purposes of the proposed research, a maximum received level of 180 dB SPL would be established above which researchers would not intentionally expose animals in order to avoid exposures that might enter the range of possible harm to the auditory system. This is also in keeping with current regulatory practices. In the Final Rule for operation of the Navy's SURTASS LFA (NMFS, 2002), NMFS concluded that

“The best available science to date indicates that if marine mammals could be excluded from an area having an SPL of 180 dB or higher, they would not likely be injured.”

The 180 dB isopleth (RL) continues to be an accepted “boundary” for a safety zone. In the 2009 programmatic biological opinion on the U.S. Navy's proposal to conduct training exercises in the Southern California Complex (NMFS 2009), NMFS stated:

“...There is limited direct empirical evidence (beyond the evidence available in Schlundt *et al.* 2000) to support a conclusion that 180 dB is “safe” for marine mammals; however, evidence from marine mammal vocalizations suggests that 180 dB is not likely to physically injure marine mammals. For example, Frankel (1994) estimated the source level for singing humpback whales to be between 170 and 175 dB; McDonald *et al.* (2001) calculated the average source level for blue whale calls as 186 dB, Watkins *et al.* (1987) found source levels for fin whales up to 186 dB, and Møhl *et al.* (2000) recorded source levels for sperm whale clicks up to 223 dBrms. Because whales are not likely to communicate at source levels that would damage the tissues of other members of their species, this evidence suggests that these source levels are not likely to damage the tissues of the endangered and threatened species being considered in this consultation.”

It is important to be able to test the validity of this assumed safety zone. NMFS in its cover letter of 25 July 2001 for the first amendment to permit no. 981-1578, quoted comments from the Marine Mammal Commission pointing out how important it is to test whether exposures to RLs up to 180 dB SPL may cause disturbance:

“The experimental protocol uses a maximum received level for all sounds except airguns of 160 dB SPL. However, this upper limit is not consistent with that proposed by the Navy (i.e. 180 dB SPL). The difference in these limits seems significant (a hundred-fold change in the intensity) and an informed judgment on the effects of SURTASS LFA or similar systems requires a measure of response to these levels. If a received sound level of 160 dB SPL or less is sufficient to cause significant behavioral changes, then the need to increase the received level to 180 dB SPL is not apparent. However, if changes observed at a received level of 160 dB SPL are deemed insignificant, **then further testing at higher levels seems necessary.**”

For the relatively short Phase I underwater MF coherent sound transmissions proposed, with low duty cycles, the permit applicant believes that a maximum exposure level of 180 dB SPL is conservative, in terms of direct injury from sound exposure, based upon TTS data, as long as the animals do not receive >10 pings at levels near 180 dB. Given the diversity of responses of marine mammals to coherent sounds, the ramp-up procedures in place to the target exposure level while continuously monitoring response, and the intent to stop the ramp-up once identifiable behavioral reactions are elicited, the permit applicant proposes a maximum RL of 180 dB for PB signals from underwater coherent MF acoustic sources. The permit applicant

would also add a margin of error for safety in each experiment to account for the possibility that the acoustic models used to predict RL at the animal are not always correct. This margin of error would be validated by comparison of estimated levels with those measured initially by the SCORE range hydrophones, and during the course of the PB by RLs measured at the animal by the tag.

4.6 Unavoidable Adverse Effects

The mitigation measures imposed by permit conditions are intended to reduce, to the maximum extent practical, the potential for adverse effects of the research on the targeted species as well as any other species that may be incidentally harassed. However, it is believed that the proposed research would have only minor short-term effects on the individual subjects. The PB experiments would only be detectable over a small portion of the seasonal range of the species present in the study area. Therefore, the proposed research would have little direct impact on the relevant species or stock. Since most of these species are now routinely exposed to increasingly loud underwater sounds, any information verifying safe exposure levels would be critical for ensuring adequate protection of these stocks from impacts of human-made noise. If the proposed carefully controlled sound exposures do indicate any effects, the data would provide critical evidence for establishing exposure criteria that might be used in modifying regulations to more effectively protect marine mammal species.

4.7 Cumulative Effects

Cumulative effects are defined as those that result from incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency (federal or nonfederal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions that take place over a period of time.

4.7.1 Intentional lethal takes

Most species of baleen whales were the targets of commercial whaling. Commercial whaling is the reason most species of large whale were listed as endangered under the ESA. Only a small number of nations currently engage in commercial whaling of a few species of baleen whales. The most common targets of modern whalers are the minke whale and sperm whale. In the past, there have been shootings of small cetaceans and pinnipeds that were thought to be interfering with commercial fishing operations, but this practice is currently prohibited under the MMPA. Since the take prohibitions of the MMPA and ESA became effective, marine mammals in the U.S. have been protected from intentional lethal take with the exception of subsistence harvests of a few species in Washington and Alaska. Although harvests may have contributed to previous declines of some species of marine mammal, intentional lethal takes are not currently considered to be a factor affecting any of the stocks in the proposed action.

Every effort would be made to ensure that PB exposures do not pose a risk to the subjects, and a primary effort of Phase I would be to define a safe behavioral indicator of risk of stranding; i.e., a response that, while safe in itself because of low intensity or short duration, can be related to a causal hypothesis for strandings that coincide with MF sonar sounds.

The PBs are designed to define the minimum exposure required to elicit the behavioral responses to be used as an indicator. They would start with low levels of exposure at the subject(s) and would not increase beyond exposure levels where identifiable behavioral reactions have been detected, until those reactions are fully analyzed. Additionally, vocal behavior would be monitored in real-time, and RLs at the subject would not be increased if animals show an unusual cessation of vocalization. Researchers would then determine how long it takes the animals to return to normal vocal behavior.

The tag attachments the permit holder proposes using have been used extensively with no evidence of injury or any problem other than temporary behavioral disruption to the tagged whale in some delphinid species (Schneider *et al.*, 1998). The tags allow researchers to follow individual marine mammals before, during, and after PB to monitor behavioral responses as well as the return to normal behavior.

This combination of careful SL ramp-up procedures, permanent monitoring hydrophones at the research location, animal tagging, and monitoring for maximum exposure levels, reduces the potential for unintended lethal takes to as low a level as is scientifically possible within the framework of a viable BRS.

4.7.2 Entrapment and entanglement in fishing gear

For most marine mammal species listed in Table 1-1, incidental capture in fishing gear is not an issue of concern relative to their population abundance and productivity rates. Estimates of annual fishing-related mortality are well below Potential Biological Removal limits established for most stocks. Actual numbers of observed and estimated fishery-related mortality by stock are provided for each species in the annual stock assessment reports, which are available from the NMFS website. Given the low numbers of interactions for most stocks, and that the effects of the proposed action would be limited to short term “Level B” harassment, the proposed action is not likely to result in cumulative impacts in combination with interactions with fisheries.

4.7.3 Vessel interactions

Collision with vessels is a cause of serious injury and mortality for large whales. However, the exact number of these collisions is not known, since most whales struck and killed by vessels tend to sink, rather than drift inshore where they might be more readily found. The proposed action is not likely to increase the number of vessel interactions since the research vessels involved would move slowly and deliberately, and for the most part, have knowledge of the location of marine mammals in their vicinity. Interactions with each of the three types of vessels involved in the proposed research are discussed below.

Tag attachment vessel (TAV)

The permit applicant proposes to use small maneuverable vessels for tag attachment. In past research, the permit applicants have successfully used 5-15 m vessels for attaching tags to animals. The animals are approached slowly, and then the tags are attached with minimal signs of disturbance using a 12+ m long cantilevered pole or a 4-5 m handheld pole. The permit

applicant proposes to continue using this successful approach for the tagging effort in this research effort.

Whale Observation/Tag tracking Vessel (OV or WTV)

Marine mammal interactions with the OV/WTC are not likely since these research vessels are constantly and purposely on the lookout for the animals. The primary requirements for the whale tracking vessel (WTV) are:

- height for antenna placement and for visual observations;
- silent propulsion and ability to deploy hydrophone array;
- ability to deploy TAV;
- cabin and bunk space for tagging team, visual monitors, and a crew of acoustic monitors to operate around the clock, if required.

One critical component of the PBs involves accurate assessment of range from the PB source to the focal animal. Researchers would measure the angle between a surfacing animal and the horizon or use laser range-finding binoculars to calculate range for animals visually sighted at the sea surface. In some circumstances, it is possible for the acoustic monitors to estimate the range to vocalizing animals as well (Thode *et al.* 2002). If the OV and PBV are separate vessels, researchers would have a data link between them to allow each platform to plot the locations of ships and animals in near-real-time. These data would be supplemented by the standard SCORE platform reconstruction data, coupled with the best estimate of animal underwater location from the range hydrophone data.

Playback vessel (PBV)

The PB vessel would be used to deploy the sound source(s) and transmit the experimental stimuli signals. It must have hardware for deploying the sound source(s) and, in the case of a vessel, suitable deck, and lab space for the source equipment and sound generation electronics (computer, power amplifiers, etc.). One critical component of the PBs involves accurate assessment of range from the PB source to the focal animal. The researchers would use laser range-finding binoculars or measure the angle between a surfacing animal and the horizon to calculate range for animals visually sighted at the sea surface. In some circumstances, it is possible for the acoustic monitors to estimate the range to vocalizing animals as well (Thode *et al.* 2002). This vessel should have a relatively quiet propulsion system to minimize potentially confounding vessel noise.

4.7.4 Other research permits

The following is a list of other currently authorized scientific research permits that have been issued for tagging or introducing sound into the marine environment that have some similarities to that in the proposed action.

- Permit no. 981-1707 (Peter Tyack, Woods Hole Oceanographic Institute) involves research into the biology, foraging ecology, communication, and behavior of a variety of cetacean species in the North Atlantic and Mediterranean Sea, including endangered whales, with a focus on their responses to anthropogenic sounds in the marine environment. It recently ended in May 2009.

- Permit no. 731-1774 (Robin Baird, Cascadia Research) involves research on all cetacean species in the Pacific Ocean to study diving and nighttime behavior, population assessment, and social organization and inter-specific interactions of cetaceans. Research includes tagging and tracking using suction-cup attached tags. This permit extends through August 2010.
- Permit no. 1121-1900 (Brandon Southall, NOAA Science and Technology) authorized a behavioral response study of deep diving odontocetes in the Bahamas (AUTEK Range). This permit extends through January 2011.
- Permit no. 87-1851 (Daniel Costa, University of California at Santa Cruz) includes research on California sea lions (*Zalophus californianus*) in California to investigate foraging and diving behavior, energetics, food habits, and at sea distribution. This permit extends through January 2012.
- File number 14241 (Tyack, Woods Hole Oceanographic Institute) involves collecting data on vocal behavior critical for estimating how well passive acoustic monitoring can detect and estimate abundance for different cetacean species, by determining what characteristics of exposure to specific sounds evoke what responses in marine mammals near the Mediterranean Sea. This 5-year research effort is scheduled to commence July 2009 and extend through July 2014.

NMFS has been issuing permits pursuant to the MMPA for research on marine mammals since the early 1970s. NMFS has also been issuing permits pursuant to the ESA for research on endangered marine mammals for several decades. The types of research methods permitted have included photo-identification, aerial and vessel surveys, passive acoustic recording, behavioral observations, collection of biopsy samples, attachment of scientific instruments, and playbacks of natural and manmade sounds. The majority of “takes” authorized by these permits have been by “Level B” harassment as it is defined under the MMPA.

Regardless of whether it is intentional or incidental, exposure to these types of research activities may have resulted in short-term behavioral responses such as alterations in swimming speed and dive patterns, or avoidance of the vessel or vicinity of playbacks. Animals may have temporarily ceased whatever activity they were engaged in at the time of exposure to the research. Depending on the location and the time of year during which the research is conducted, the subject species could be engaged in social interactions, feeding, breeding activities, and traveling, depending on the species.

Physiological responses are likely to occur in conjunction with or independent of observable behavioral responses. These responses would be mostly undetectable or immeasurable (except perhaps with use of scientific instruments or analysis of tissue samples), but are likely to include short-term changes in heart rate and respiration (either as a result of increased physical activity or in the absence of such behavioral changes), and temporarily increased circulating levels of stress hormones.

Most of these types of research methods require animals be closely approached. Exposure to close approaches alone is not expected to result in physical injury or pain as there would be no physical or otherwise intrusive contact with the animals. Exposure to playbacks is not expected

to result in physical injury or pain given the sound sources permitted, received levels, and mitigation measures that would be employed by the researchers.

The only research activities that would involve physical contact with the whales would be attachment of scientific instruments or collection of biopsy samples, which could result in minor injury. The whales may exhibit short-term behavioral responses to tag attachment or biopsy sampling. Observed behavioral responses to these activities have included sudden changes in swimming speed or direction or short-term changes in dive patterns.

Issuance of the proposed permit is not expected to increase appreciably the number of marine mammals exposed to or affected by permitted research. The research in the proposed action would be of short temporal duration, limited geographic scope, and is likely to result in short-term adverse impacts on individual target and non-target endangered marine mammals. Due to the limited duration and location, as well as the anticipated short-term nature of responses, the permitted research is not expected to result in long-term or cumulative impacts on individual endangered marine mammals or marine mammal species.

Although it is not possible to describe the extent of overlap under these research permits, NMFS permits for research on marine mammals require that researchers coordinate their activities with those of other permit holders to avoid unnecessary disturbance of animals). Permitted researchers are also required to notify the appropriate NMFS Regional Office at least two weeks in advance of any planned field work so that the Regional Office can facilitate this coordination and take other steps appropriate to minimize disturbance from multiple permits.

4.7.5 Habitat degradation

Loss of habitat is a primary cause of the decline of many species worldwide. Habitat loss does not have to result from physical exclusion from an area (as can occur with some construction activities). Marine mammals may be indirectly affected by a variety of other human activities, including discharges from wastewater systems, dredging, ocean dumping and disposal, and aquaculture. In the North Pacific, undersea exploitation and development of mineral deposits, as well as dredging of major shipping channels pose a continued threat to the coastal habitat of right whales. Point-source pollutants from coastal runoff, offshore mineral and gravel mining, at-sea disposal of dredged materials and sewage effluent, potential oil spills, as well as substantial commercial vessel traffic, and the impact of trawling and other fishing gear on the ocean floor are continued threats to right whales in the North Atlantic. None of these habitat degradation causes relate to the proposed BRS field research.

The impact of ocean contamination on the health of marine mammal populations has been investigated with increasing interest, with particular focus on chemicals that persist in the environment, such as the organochlorines. These chemicals tend to bioaccumulate through the food chain, thereby increasing the potential of indirect exposure to a marine mammal via its food source. During pregnancy and nursing, some of these contaminants can be passed from the mother to developing offspring. Contaminants like organochlorines do not tend to accumulate in significant amounts in invertebrates, but do accumulate in fish and fish-eating animals. Thus, contaminant levels in planktivorous mysticetes have been reported to be one to two orders of magnitude lower compared to piscivorous odontocetes (Borell, 1993; O'Shea and Brownell,

1994; O'Hara and Rice, 1996; O'Hara *et al.*, 1999). None of these habitat degradation causes relate to the proposed BRS field research.

Given that the BRS target species within the SOCAL range complex have been exposed to sonar transmissions on numerous occasions over the past few decades, and their abundance and densities have not measurably decreased, the introduction of sound source transmissions during the short-term proposed BRS field research is not likely to cause habitat degradation.

4.7.6 Noise

Animals inhabiting the marine environment are continually exposed to many sources of sound. Naturally occurring sounds such as lightning, rain, subsea earthquakes, and animal vocalizations (*e.g.*, whale songs) occur regularly. The noise from airplanes and helicopters, recreational boating and commercial shipping, is a source of potential disturbance. Many researchers have described behavioral responses of marine mammals to the sounds produced by helicopters and fixed-wing aircraft, boats and ships, as well as dredging, construction, geological explorations, etc. (Richardson *et al.*, 1995). Most observations have been limited to short-term behavioral responses, which included cessation of feeding, resting, or social interactions. Several studies have demonstrated short-term effects of disturbance on humpback whale behavior (Baker *et al.* 1983; Bauer and Herman 1986; Hall 1982; Krieger and Wing 1984), but the long-term effects, if any, are unclear or not detectable. Marine mammals can be found in areas of intense human activity, suggesting that some individuals or populations may tolerate, or have become habituated to, certain levels of exposure to noise (Richardson *et al.*, 1995). For example, baleen whales, including right whales, are consistently found within the shipping lanes of the St. Lawrence estuary and off Cape Cod despite frequent exposure to vessels. Such tolerance is likely related to the importance of the area to feeding and/or migrating whales and a certain degree of habituation. It is not clear whether such chronic exposure to anthropogenic noise has adverse physiological effects or whether potential masking of communication sounds is having negative impacts on social behaviors.

There is evidence that anthropogenic noise has increased the ambient level of sound in the ocean over the last 50 years. Much of this increase is due to increased shipping as ships become more numerous and of larger tonnage. Commercial fishing vessels, cruise ships, transport boats, and recreational boats all contribute sound into the ocean. The military uses sound to test the construction of new vessels as well as for naval operations. In areas such as the Gulf of Mexico where oil and gas production takes place, noise originates from the drilling and production platforms, tankers, vessel and aircraft support, seismic surveys, and the explosive removal of platforms. Currently over 100 seismic survey vessels operate throughout the world with airgun array SLs of up to 260 dB re 1 μ Pa at 1 m (far field estimate) or more. Hundreds of naval vessels operate high power sonars with SLs of up to 240 dB SPL. Sonars used for depth sounding and bottom profiling often operate in the 1-12 kHz frequency band with SLs similar to that of the whale-finding sonar (Richardson *et al.*, 1995). Most ships operate depth-sounding sonars continuously while at sea and bottom profilers are commonly used research tools.

In regards to this proposed study, introducing natural sounds, novel synthetic sounds, and coherent/incoherent sounds into the marine environment, the playback experiments involve controlled exposures that are less frequent and lower in level than many that these species may

face from incidental commercial sources. The maximum level of exposure is lower than or equal to the exposures restricted by regulation due to the likelihood of physical injury. If this research, as anticipated, helps in the formulation/modifications of regulations improving the protection of ESA or MMPA species from noise exposure, then this would help the stocks, as individual animals are protected by monitoring and mitigation measures and as acoustic habitat degradation is reversed. In this context, it is essential to work with those species thought to be most sensitive.

4.7.7 Cumulative Effects Conclusion

Given the information provided in Subchapter 4.7, the potential impact due to cumulative effects from the BRS is considered to be extremely small. The BRS would introduce natural and artificial underwater sounds into the marine environment. However, due to the short duration of the BRS, it would not add appreciably to the underwater sounds to which fish, sea turtles, and marine mammals are already exposed. Even though the BRS would produce additional sound, this research is considered to be beneficial to the species in that it would provide data on the behavioral response effects of marine mammals to controlled acoustic exposures. This research could then lead to the formulation/modifications of regulations improving the protection of ESA or MMPA species from noise exposure and thus benefiting stocks of marine animals around the world. Finally, given the controlled exposure approach and specific protective protocols, the BRS is not expected to result in any direct injury or lethal takes of marine mammals.

CHAPTER 5. LIST OF PREPARERS

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APPENDIX A: PERMIT CONDITIONS

The following table outlines the conditions that are included in permits for research on marine mammals issued by NMFS under the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA). Some conditions derive from the permit requirements of the MMPA and others from NMFS regulations for permits. The language of the conditions may vary slightly in actual permits, but still address the underlying statutory or regulatory requirements. The purpose or reason for each condition is briefly explained.

Table 1. General Marine Mammal Research Permit Terms and Conditions. All permits for research on marine mammals specify that the activities authorized by the permit must occur by the means, in the areas, and for the purposes set forth in the permit application, and as limited by the following Terms and Conditions specified in the permit, including all attachments and appendices. These conditions originate from the permit requirements of the MMPA and NMFS regulations for permits.

Condition	Origin	Purpose
<i>Duration of permit</i>		
Personnel listed in this permit (hereinafter “Researchers”) may conduct activities authorized by this permit through [a specified expiration date that varies by permit]. This permit expires on the date indicated and is non-renewable	MMPA section 104(b)(2)(C) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify duration of permitted activity.
Researchers must suspend all permitted activities in the event serious injury or mortality of protected species reaches that specified in the permit.	MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” NMFS requires this condition to ensure research does not exceed levels of serious injury and mortality determined acceptable for a given species.
If authorized take is exceeded, Researchers must cease all permitted activities and notify the Permits Division as soon as possible, but no later than within two business days. The Permit Holder must also submit a written incident report as described in the reporting section of this permit. Research may	MMPA section 104(b)(2)(D) and regulations at 50 CFR	Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” NMFS requires this condition to ensure real-time adaptive management of adverse effects of research.

Condition	Origin	Purpose
resume with written permission from NMFS.	Part 216.36	
<i>Number and Kind(s) of Protected Species, Location(s) and Manner of Taking</i>		
The tables in this permit outline the number of protected species, by species and stock, authorized to be taken, and the locations, manner, and time period in which they may be taken.	MMPA section 104(b)(2)(A)-(B) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify the number and kind of animals authorized to be taken, and the location and manner in which they may be taken.
Researchers must comply with the following conditions related to the manner of taking [a list of taxonomic or activity specific conditions that varies by permit]	MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” NMFS requires these conditions to minimize adverse effects of research activities including capture, sampling, and disturbance. (See Table 2 below for conditions common to pinniped research permits.)
Researchers working under this permit may collect visual images (<i>i.e.</i> , any form of still photographs and motion pictures) as needed to document the permitted activities, provided the collection of such images does not result in takes of protected species.	50 CFR Part 216.41(c)(vii)	Regulations require that any activity conducted incidental to the authorized scientific research activity (<i>i.e.</i> , educational and commercial photography) must not involve any taking of marine mammals beyond what is necessary to conduct the research.
The Permit Holder may use visual images collected under this permit in printed materials (including commercial or scientific publications) and presentations provided the images are accompanied by a statement indicating that the activity depicted was conducted pursuant to a NMFS Permit. This statement must accompany the images in all subsequent uses or sales.	MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” NMFS requires this condition to ensure visual images of permitted research acknowledge the appropriate permit authority for the activity.

Condition	Origin	Purpose
Upon written request from the Permit Holder, approval for photography, filming, or audio recording activities not essential to achieving the objectives of the permitted activities, including allowing personnel not essential to the research (e.g. a documentary film crew) to be present, may be granted by the Chief, Permits Division.	MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” This condition allows researchers to record or document their research for educational or other purposes.
Where such non-essential photography, filming, or recording activities are authorized they must not influence the conduct of permitted activities in any way or result in takes of protected species.	50 CFR Part 216.41(c)(vii)	Regulations require that any activity conducted incidental to the authorized scientific research activity (i.e., educational and commercial photography) must not involve any taking of marine mammals beyond what is necessary to conduct the research.
Personnel authorized to accompany the Researchers during permitted activities for the purpose of non-essential photography, filming, or recording activities are not allowed to participate in the permitted activities.	50 CFR Part 216.35(g)	Regulations require that individuals conducting activities under the permit possess qualifications commensurate with their duties and responsibilities. This condition therefore limits photographers, audiographers, and film crew to conduct of photography, filming and other recording activities.
The Permit Holder and Researchers cannot require or accept compensation in return for allowing non-essential personnel to accompany Researchers to conduct non-essential photography, filming, or recording activities.	50 CFR Part 216.35(i)	Regulations state that permit holders may not require any direct or indirect compensation from another person in return for requesting authorization for such person to conduct [activities] authorized under the subject permit.
<i>Qualifications, Responsibilities, and Designation of Personnel</i>		
The following Researchers may participate in the conduct of the permitted activities in accordance with their qualifications and the limitations specified herein: [a list of names of the Principal Investigator, Co-investigators, and Research Assistants]	MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” This condition identifies those individuals NMFS has determined qualified to participate in permitted research, and the degree of qualification (PI, CI, RA) relative to the research activities.
Individuals conducting permitted activities must possess qualifications commensurate with their roles and	50 CFR Part 216.35(g)	Regulations require that individuals conducting activities under the permit possess qualifications commensurate with their duties

Condition	Origin	Purpose
responsibilities		and responsibilities.
The Permit Holder is ultimately responsible for all activities of any individual who is operating under the authority of this permit. Where the Permit Holder is an institution/facility, the Responsible Party is the person at the institution/facility who is responsible for the supervision of the Principal Investigator.	50 CFR Part 216.35(f)	Regulations state that the permit holder is responsible for all activities of any individual who is operating under the authority of the permit.
The Principal Investigator (PI) is the individual primarily responsible for the taking, import, export and any related activities conducted under the permit. The PI must be on site during any activities conducted under this permit unless a Co-Investigator named in this permit is present to act in place of the PI.	50 CFR Part 216.3 and Part 216.41(c)(iii)	Regulations define Principal Investigator as the individual primarily responsible for the taking, import, export and any related activities conducted under a permit issued for scientific research. Regulations regarding permit restrictions also require that research activities be conducted under the direct supervision of the principal investigator or a co-investigator identified in the permit.
Co-Investigators (CIs) are individuals who are qualified to conduct activities authorized by the permit without the on-site supervision of the PI. CIs assume the role and responsibility of the PI in the PI's absence.	50 CFR Part 216.41(c)(iii) and Part 216.35(g)	This condition defines the role and responsibility of co-investigators and derives from the regulatory restrictions for permits.
Research Assistants (RAs) are individuals who work under the direct and on-site supervision of the PI or a CI. RAs cannot conduct permitted activities in the absence of the PI or a CI.	50 CFR Part 216.41(c)(iii) and Part 216.35(g)	This condition defines the role and responsibility of research assistants and derives from the regulatory restrictions for permits.
Personnel involved in permitted activities must be reasonable in number and essential to conduct of the permitted activities. Essential personnel are limited to: individuals who perform a function directly supportive of and necessary to the permitted activity (including operation of any vessels or aircraft essential to conduct of the activity); individuals included as backup for those personnel essential to the conduct of the permitted activity; and individuals included for training purposes.	50 CFR Part 216.41(c)(iv)	Regulations regarding permit restrictions state that personnel involved in permitted research be reasonable in number and limited to individuals who perform a function directly supportive of and necessary to the permitted activity [i.e., "essential" personnel]; and support personnel included for the purpose of training or as backup for "essential" personnel.
Persons who require state or federal licenses to conduct	50 CFR Part	Regulations state that persons who require state or federal

Condition	Origin	Purpose
activities authorized under the permit (<i>e.g.</i> , veterinarians, pilots) must be duly licensed when undertaking such activities.	216.35(h)	licenses to conduct activities authorized under the permit must be duly licensed when undertaking such activities.
Permitted activities may be conducted aboard vessels or aircraft, or in cooperation with individuals or organizations, engaged in commercial activities, provided the commercial activities are not conducted simultaneously with the permitted activities.	MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” This condition allows researchers to use platforms of opportunity for conduct of their research but prohibits use of research permits for commercial activities.
The Permit Holder may request authorization from the Permits Division to add personnel to this permit as indicated below. The Permit Holder cannot require or receive any direct or indirect compensation in return for requesting authorization for such person to act as a PI, CI, or RA under the permit.	50 CFR Part 216.35(i)	Regulations state that permit holders may not require any direct or indirect compensation from another person in return for requesting authorization for such person to conduct [activities] authorized under the subject permit.
<i>Possession of Permit</i>		
This permit cannot be transferred or assigned to any other person.	50 CFR Part 216.35(i)	Regulations state that special exception permits are not transferable or assignable to any other person.
The Permit Holder and all other persons operating under the authority of this permit must possess a copy of this permit: when engaged in a permitted activity; when a protected species is in transit incidental to a permitted activity; and during any other time when any protected species taken or imported under such permit is in the possession of such persons.	MMPA section 104(f) and regulations at 50 CFR Part 216.35(j)	This condition is paraphrased from statutory and regulatory text regarding possession of the permit.
A duplicate copy of this permit must be attached to the container, package, enclosure, or other means of containment in which a protected species or protected species part is placed for purposes of storage, transit, supervision or care.	MMPA section 104(f) and regulations at 50 CFR Part 216.35(j)	This condition is paraphrased from statutory and regulatory text regarding possession of the permit.
<i>Reports</i>		

Condition	Origin	Purpose
The Permit Holder must submit annual, final, and incident reports, and any papers or publications resulting from the research authorized herein to the Chief, Permits Division,	MMPA section 104(c)(1) and regulations at 50 CFR Part 216.38	The statute requires any person authorized to take a marine mammal for scientific research to furnish to [NMFS] a report on all activities carried out pursuant to that authority. Regulations require all permit holders to submit annual, final, and special reports in accordance with the requirements established in the permit, and any reporting format established by the Office Director.
Written incident reports related to serious injury and mortality events or to exceeding authorized takes, must be submitted to the Chief, Permits Division within two weeks of the incident. The incident report must include a complete description of the events and identification of steps that will be taken to reduce the potential for additional research-related mortality or exceedence of authorized take.		The purpose of incident (special) reports is to monitor effects of research and effectiveness of permit conditions for mitigation of adverse effects.
An annual report must be submitted to the Chief, Permits Division by [a specified date that varies by permit but which is usually 90 days following the anniversary of permit issuance] for each year the permit is valid. The annual report describing activities conducted during the previous permit year must follow the format in [an Appendix with specific questions and format requirements].		The purpose of annual and final reports is to monitor permit compliance and effects of research on marine mammals. Annual and final reports also demonstrate the permit holder's progress toward achieving stated objectives of their study.
A final report must be submitted to the Chief, Permits Division within 180 days after expiration of the permit, or, if the research concludes prior to permit expiration, within 180 days of completion of the research.		
Research results must be published or otherwise made available to the scientific community in a reasonable period of time.	50 CFR Part 216.41(c)(ii)	Regulations require that research results be published or otherwise made available to the scientific community in a reasonable period of time. Note that the statutory definition of bona fide research includes "results of which likely would be accepted for publication in a refereed scientific journal."
<i>Notification and Coordination</i>		
The Permit Holder must provide written notification of planned	MMPA section	Statute and regulations require that permits specify "any other

Condition	Origin	Purpose
field work to the appropriate Assistant Regional Administrators for Protected Resources. Such notification must be made at least two weeks prior to initiation of any field trip/season and must include the locations of the intended field study and/or survey routes, estimated dates of research, and number and roles (for example: PI, CI, veterinarian, boat driver, safety diver, animal restrainer, Research Assistant “in training”) of participants.	104(b)(2)(D) and regulations at 50 CFR Part 216.36	terms and conditions which [NMFS] deems appropriate.” NMFS requires this condition to facilitate NMFS Regional Offices’ coordination and monitoring of permitted activities in each specific geographic area.
To the maximum extent practical, the Permit Holder must coordinate permitted activities with activities of other Permit Holders conducting the same or similar activities on the same species, in the same locations, or at the same times of year to avoid unnecessary disturbance of animals. The appropriate Regional Office may be contacted for information about coordinating with other Permit Holders.	MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” NMFS requires this condition to promote coordination among permitted researchers to minimize unnecessary overlap of research in time and space and the resulting disturbance of animals.
<i>Observers and Inspections</i>		
NMFS may review activities conducted pursuant to this permit. At the request of NMFS, the Permit Holder must cooperate with any such review by: allowing any employee of NOAA or any other person designated by the Director, NMFS Office of Protected Resources to observe permitted activities; and providing any documents or other information relating to the permitted activities.	MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36	Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” NMFS requires this condition to facilitate monitoring of research for compliance with the terms and conditions of the permit. Note also that this condition is consistent with, and paraphrased from, regulatory requirements for the General Authorization (50 CFR Part 216.45(d)(7))
<i>Modification, Suspension, and Revocation</i>		
All permits are subject to suspension, revocation, modification, and denial in accordance with the provisions of subpart D (Permit Sanctions and Denials) of 15 CFR Part 904.	50 CFR Part 216.40	This condition is taken directly from the regulations.
The Director, NMFS Office of Protected Resources may modify, suspend, or revoke this permit in whole or in part: (1) In order to make the permit consistent with any change made after the date of permit issuance with respect to any applicable	MMPA section 104(e)	Parts 1 and 2 of this condition are taken directly from the corresponding section of the statute. Part 3 derives from the regulatory requirements for permit amendments. Part 4 derives from the statutory and regulatory requirement that permits

Condition	Origin	Purpose
<p>regulation prescribed under section 103 of the MMPA and section 4 of the ESA; (2) In any case in which a violation of the terms and conditions of the permit is found; (3) In response to a written request from the Permit Holder; (4) If NMFS determines that the application or other information pertaining to the permitted activities (including, but not limited to, reports pursuant to [other sections] of this permit and information provided to NOAA personnel pursuant to [other sections] of this permit) includes false information; and (5) If NMFS determines that the authorized activities will operate to the disadvantage of threatened or endangered species or are otherwise no longer consistent with the purposes and policy in Section 2 of the ESA.</p>	<p>and Regulations at 50 CFR Part 216.39 and 50 CFR Part 216.36 and ESA section 10(d)</p>	<p>specify “any other terms and conditions which [NMFS] deems appropriate.” This condition allows NMFS to take appropriate action should it discover an applicant has falsified information in their application or other permit related information (e.g., permit reports). Part 5 implements part of the ESA section 10(d) requirements.</p>
<p>Issuance of this permit does not guarantee or imply that NMFS will issue or approve subsequent permits or amendments for the same or similar activities requested by the Permit Holder, including those of a continuing nature.</p>	<p>MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36</p>	<p>Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” This condition clarifies that each application for a permit, including permit amendments, must satisfy the applicable statutory and regulatory issuance requirements, independent of previous permits.</p>
<p><i>Penalties and Permit Sanctions</i></p>		
<p>Any person who violates any provision of this permit, the MMPA, ESA, or the regulations at 50 CFR 216 and 50 CFR 222-226 is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the MMPA, ESA, and 15 CFR part 904.</p>	<p>MMPA section 105 and regulations at 50 CFR Part 216.40(a)</p>	<p>This condition is paraphrased from the statute and regulations.</p>

Condition	Origin	Purpose
<p>NMFS shall be the sole arbiter of whether a given activity is within the scope and bounds of the authorization granted in this permit. The Permit Holder must contact the Permits Division for verification before conducting the activity if they are unsure whether an activity is within the scope of the permit. Failure to verify, where NMFS subsequently determines that an activity was outside the scope of the permit, may be used as evidence of a violation of the permit, the MMPA, the ESA, and applicable regulations in any enforcement actions.</p>	<p>MMPA section 104(b)(2)(D) and regulations at 50 CFR Part 216.36</p>	<p>Statute and regulations require that permits specify “any other terms and conditions which [NMFS] deems appropriate.” This condition clarifies that permits are not subject to interpretation by the permit holder and that NMFS’s has exclusive authority regarding interpretation of the permit.</p>
<p><i>Acceptance of Permit</i></p>		
<p>In signing this permit, the Permit Holder Agrees to abide by all terms and conditions set forth in the permit, all restrictions and relevant regulations under 50 CFR Parts 216, and 222-226, and all restrictions and requirements under the MMPA, and the ESA; Acknowledges that the authority to conduct certain activities specified in the permit is conditional and subject to authorization by the Office Director; and Acknowledges that this permit does not relieve the Permit Holder of the responsibility to obtain any other permits, or comply with any other Federal, State, local, or international laws or regulations.</p>	<p>50 CFR Part 216.33(e)(3)(i) and (ii)</p>	<p>This condition is paraphrased from the regulations regarding permit issuance. This condition also clarifies that the authority conferred by the permit to take marine mammals in exception to the MMPA’s prohibitions does not confer to the permit holder authority under any other laws.</p>



Finding of No Significant Impact Issuance of Scientific Research Permit No. 14534

Background

In August 2009, the National Marine Fisheries Service (NMFS) received an application for a permit (File No. 14534) from the NOAA Office of Science and Technology (Principal Investigator: Dr. Brandon Southall) to conduct research on marine mammals in waters off California. In accordance with the National Environmental Policy Act, NMFS has prepared an Environmental Assessment (EA) analyzing the impacts on the human environment associated with permit issuance (Final Environmental Assessment on the Effects of Scientific Research Activities Associated with Behavioral Response Studies of Pacific Marine Mammals Using Controlled Sound Exposure; 2010). The analyses in the EA support the findings and determination below. NMFS has chosen to issue a permit for activities as described in Alternative 2 of the EA.

Analysis

National Oceanic and Atmospheric Administration Administrative Order 216-6 (May 20, 1999) contains criteria for determining the significance of the impacts of a proposed action. In addition, the Council on Environmental Quality (CEQ) regulations at 40 C.F.R. 1508.27 state that the significance of an action should be analyzed both in terms of “context” and “intensity.” Each criterion listed below is relevant to making a finding of no significant impact and has been considered individually, as well as in combination with the others. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ’s context and intensity criteria. These include:

1) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in Fishery Management Plans?

Issuance of a permit as described in Alternative 2 of the EA is not reasonably expected to cause substantial damage to ocean and coastal habitats or essential fish habitat (EFH). Conduct of the research authorized by the permit is not likely to result in permanent or large-scale damage to components of ocean and coastal habitat in the action area. Neither the researchers or their equipment will come into contact with physical substrate or structures.

Conduct of the research authorized by the permit is not likely to affect EFH because it does not involve nor will it result in activities that have been shown to affect EFH including disturbance or destruction of habitat from stationary fishing gear, dredging and filling, agricultural and urban runoff, direct discharge, or the introduction of exotic species.



2) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

Issuance of the permit is not expected to affect biodiversity or ecosystem function. The research authorized by the permit is not likely to alter foraging patterns, dietary preferences, or relative distribution or abundance of species groups within the area. The research activities will not affect nutrient flux, primary productivity, or other factors related to ecosystem function in the area.

3) Can the proposed action reasonably be expected to have a substantial adverse impact on public health or safety?

Issuance of the permit it is not expected to affect public health or safety. Conduct of the research authorized by the permit is not expected to affect things typically associated with impacts on public health and safety such as traffic and transportation patterns; noise levels; risks of exposure to hazardous materials and wastes; risks of contracting disease; risks of damages from natural disasters; or food safety.

4) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species?

Issuance of the permit is not expected to adversely affect endangered or threatened species, marine mammals, critical habitat, etc. Conduct of the research authorized by the permit will directly and indirectly result in adverse effects on a specified number of animals targeted by the research, as well as non-target animals in the immediate vicinity of the research. Given the mitigation measures required by the permit, these adverse effects are likely to result only in transitory and recoverable changes in behavior and physiological parameters of the affected animals, including those listed as threatened or endangered, but are not expected to result in measurable effects on populations, stocks, or species.

Conduct of the permitted research is not expected to adversely affect critical habitat because none is designated within the area.

5) Are significant social or economic impacts interrelated with natural or physical environmental effects?

There are no significant social or economic impacts interrelated with potential natural or physical impacts of the action. Conduct of the permitted research will result in insignificant effects on the natural and physical environment, but there are no significant social or economic impacts interrelated with these effects. The research does not involve and is not associated with factors typically related to effects on the social and economic environment such as inequitable distributions

of environmental burdens, differential access to natural or depletable resources in the action area.

6) Are the effects on the quality of the human environment likely to be highly controversial?

The application and draft EA were made available for public review and comment. There is no substantial dispute as to the project's size, nature, or effect, nor were questions raised with respect to the significance of any environmental impacts identified in the draft EA.

Research involving exposing marine mammals to sound has been the subject of public controversy for previous permits. That controversy was not related to uncertainty about impacts but represented opposition to the research in general. The likely adverse effects of the techniques in the subject permit are limited to a specified number of marine mammals targeted by the research and are predicted to involve only transitory stress, but no pain or injury. Although the precise levels of a sound that will provoke a behavioral response may be uncertain, and the research seeks to provide answers to this question, there is no substantial dispute as to what resources will be affected, or the temporal and geographic scale of those effects.

7) Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas?

Issuance of the permit is not expected to affect unique or ecologically critical areas. Conduct of the permitted research is not expected to substantially impact unique or ecologically critical areas. The research does not involve contact with or activities that may indirectly impact physical structures or features of the environment. The sound propagation in the water column will not result in impacts on unique or ecologically critical areas.

8) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

The effects of the permitted research on the human environment are not highly uncertain and the research does not involve unique or unknown risks. The permitted research does not involve techniques for which the risks to and effects on the biological and physical environment cannot reasonably be predicted based on monitoring reports from previously permitted research and published literature on the effects of human activities on marine mammals and other wildlife.

9) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?

Issuance of the permit will not result in individually or cumulatively significant impacts. The EA considered the other activities affecting the resources in the area. The impacts of this action are expected to be short-term and transitory.

Conduct of the permitted research is not related to other federal actions. Results of the research may inform future management actions. However, those future actions are too speculative to evaluate at this time and would themselves be subject to consideration under NEPA.

10) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources?

Issuance of the permit will not adversely affect the above mentioned places and resources. Conduct of the permitted research will not affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places because none are present in the action area and the effects of the research are limited to resources within the action area. Conduct of the permitted research will not cause loss or destruction of significant scientific or historical resources as none are present.

11) Can the proposed action reasonably be expected to result in the introduction or spread of a non-indigenous species?

Issuance of the permit is not expected to result in the spread or introduction of non-indigenous species. Conduct of the permitted research is not reasonably expected to result in the spread or introduction of non-indigenous species. The research does not involve handling animals in the wild, or transporting animals among locations. The research does not involve movement of vessels, or researchers and their equipment, among water bodies. There are no routes by which non-indigenous organisms can be transmitted or introduced by the research.

12) Is the proposed action likely to establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration?

The proposed action does not establish a precedent for future actions with significant effects nor represent a decision in principle about a future consideration. Issuance of the permit enables the applicant to conduct research on marine mammals consistent with provisions of the Marine Mammal Protection Act, Endangered Species Act, and applicable regulations. These provisions are applicable to all such permits and decision to issue. It does not involve an irreversible or irretrievable commitment of resources, limit the choice of reasonable alternatives for future decisions, or otherwise represent a decision in principle about future considerations.

13) Can the proposed action reasonably be expected to threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment?

No. Issuance of the permit will be consistent with provisions of the Marine Mammal Protection Act, Endangered Species Act, and applicable regulations.

Conduct of the research may require the applicant to secure additional federal, State or local permissions, e.g., access to State Parks or Marine Sanctuaries. NMFS did not identify any components of the research that would preclude obtaining such permissions.

14) Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?

Issuance of the permit cannot reasonably be expected to result in cumulative adverse effects substantially affecting target or non-target species. Conduct of the permitted research will result in adverse impacts on a specified number of target animals and on non-target animals in the immediate vicinity of the research. These adverse impacts are expected to be transitory and recoverable and, when considered in combination with other actions or factors affecting the populations, stocks, and species, not likely to result in significant impacts on the species or the environment.

DETERMINATION

In view of the information presented in this document, and the analyses contained in the EA prepared for issuance of Permit No. 14534, it is hereby determined that permit issuance will not significantly impact the quality of the human environment. In addition, all beneficial and adverse impacts of the proposed action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an Environmental Impact Statement for this action is not necessary.

for 
James H. Lecky
Director, Office of Protected Resources

June 29, 2010
Date