Dated in Washington, DC, August 25, 2008.

**Christopher Byrnes,**

*Chief, Regional Programs Coordination Unit.*

[FR Doc. E8–19995 Filed 8–27–08; 8:45 am]

BILLING CODE 6335–01–P

## DEPARTMENT OF COMMERCE

### Economic Development Administration

### Notice of Petitions by Firms for Determination of Eligibility To Apply for Trade Adjustment Assistance

**AGENCY:** Economic Development Administration, Department of Commerce.

**ACTION:** Notice and opportunity for public comment.

Pursuant to section 251 of the Trade Act of 1974 (19 U.S.C. 2341 *et seq.*), the Economic Development Administration (EDA) has received petitions for certification of eligibility to apply for Trade Adjustment Assistance from the firms listed below. EDA has initiated separate investigations to determine whether increased imports into the United States of articles like or directly competitive with those produced by each firm contributed importantly to the total or partial separation of the firm's workers, or threat thereof, and to a decrease in sales or production of each petitioning firm.

LIST OF PETITIONS RECEIVED BY EDA FOR CERTIFICATION OF ELIGIBILITY TO APPLY FOR TRADE ADJUSTMENT JUNE 24, 2008–AUGUST 7, 2008

| Firm | Address | Date accepted for filing | Products |
|---|---|---|---|
| Metalworks Worldwide Inc. | 3180 Berea Rd., Cleveland, OH 44111 | 6/24/2008 | Stamped parts of steel and aluminum. |
| Driv-Lok, Inc. | 1140 Park Avenue, Sycamore, IL 60178 | 7/28/2008 | Metal fabricated press fit fasteners including pins, studs and dowels. |
| Washington Marble Works, Inc. | 1016 Zchinder Street, Sumner, WA 98390. | 7/31/2008 | Granite countertops as well as fireplaces and other custom products made from tile, limestone, and travertine. |
| Metal Guru, Inc. dba Vicious Cycles | 205 South Ohioville Road, New Paltz, NY 12561. | 8/7/2008 | Titanium and steel bicycles, and bicycle accessories. Paint and repaint services. |
| Master Tech Tool, Inc. | 4539 Prime Parkway, McHenry, IL 60050-7000. | 6/27/2008 | Compression and plastic injection molds. |
| Electric Motors and Specialties, Inc. | 701 W. King St., Garrett, IN 46738 | 6/27/2008 | Unit bearing, cast iron electric motors. |
| Intronics, Inc. | 1400 Providence Highway, Norwood, MA 02062. | 6/30/2008 | Standard and custom analog function modules. |

Any party having a substantial interest in these proceedings may request a public hearing on the matter. A written request for a hearing must be submitted to the Office of Performance Evaluation, Room 7009, Economic Development Administration, U.S. Department of Commerce, Washington, DC 20230, no later than ten (10) calendar days following publication of this notice. Please follow the procedures set forth in Section 315.9 of EDA's final rule (71 FR 56704) for procedures for requesting a public hearing. The Catalog of Federal DomesticAssistance official program number and title of the program under which these petitions are submitted is 11.313, Trade Adjustment Assistance.

Dated: August 19, 2008.

**William P. Kittredge,**

*Program Officer for TAA.*

[FR Doc. E8–19615 Filed 8–27–08; 8:45 am]

BILLING CODE 3510–24–P

## DEPARTMENT OF COMMERCE

### National Oceanic and Atmospheric Administration

**RIN 0648–XJ24**

### Incidental Takes of Marine Mammals During Specified Activities; Low-Energy Marine Seismic Surveys in the Santa Barbara Channel, November 2008

**AGENCY:** National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

**ACTION:** Notice; proposed incidental take authorization; request for comments.

**SUMMARY:** NMFS has received an application from the Scripps Institute of Oceanography (SIO) for an Incidental Harassment Authorization (IHA) to take small numbers of marine mammals, by harassment, incidental to conducting a seismic survey within the Santa Barbara Channel, California. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS requests comments on its proposal to authorize SIO to take, by Level B harassment only, small numbers of marine mammals incidental to conducting a marine seismic survey in November, 2008.

**DATES:** Comments and information must be received no later than September 29, 2008.

**ADDRESSES:** Comments on the application should be addressed to Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3225. The mailbox address for providing e-mail comments is *PR1.0648-XJ24@noaa.gov.* Comments sent via e-mail, including all attachments, must not exceed a 10-megabyte file size.

A copy of the application containing a list of the references used in this document may be obtained by writing to the address specified above, telephoning the contact listed below (see **FOR FURTHER INFORMATION CONTACT**), or visiting the Internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.*

Documents cited in this notice may be viewed, by appointment, during regular business hours, at the aforementioned address.

**FOR FURTHER INFORMATION CONTACT:** Jaclyn Daly or Howard Goldstein, Office of Protected Resources, NMFS, (301) 713–2289.

**SUPPLEMENTARY INFORMATION:**

## Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of marine mammals by United States citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization for incidental taking shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses, and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''. . . an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.''

Section 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' 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 disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [''Level B harassment''].

Section 101(a)(5)(D) establishes a 45-day time limit for NMFS' review of an application followed by a 30-day public notice and comment period on any proposed authorizations for the incidental harassment of small numbers of marine mammals. Within 45 days of the close of the comment period, NMFS must either issue or deny issuance of the authorization.

## Summary of Request

On June 27, 2008, NMFS received an application from SIO for the taking, by Level B harassment only, of small numbers of 16 species of marine mammals incidental to conducting a twelve-day, low-energy marine seismic survey within the Santa Barbara Channel, CA, in November 2008. The funding for this research survey is provided by the National Science Foundation (NSF).

The purpose of the proposed study is to test the feasibility of extending the paleoclimate record from Santa Barbara Basin established in 1992 and 2005 from ~700,000 years ago back to ~1.2 million years using detailed 3D modeling of the structure and outcrop stratigraphy of the northern shelf, to locate optimal core sites, and high-resolution multichannel seismic (MCS) reflection site surveys, test coring, and core analyses in the northern shelf and mid-channel areas. The planned seismic survey (including turns) will consist of approximately 600 km of survey lines using a standard 45-in$^3$ GI airgun and approximately 500 km of survey lines using a mini-sparker or boomer. The seismic surveys will identify subsequent optimal and safe coring strategies suitable for recovering a continuous paleoclimate record from the shallow marine sediments in Santa Barbara Basin in the future as part of the Integrated Ocean Drilling Program (IODP).

## Description of the Specified Activity

The planned survey will involve one source vessel, the seismic ship R/V *Melville,* owned by the U.S. Navy and operated by SIO. The *Melville* is expected to depart San Diego and spend approximately 12 days conducting the survey and piston coring activities in November 2008. Seismic operations will be conducted during daylight hours only for 1–2 days at each of five sites encompassing the small area approximately 34–34.5° N, 119.5–120° W, north and northwest of Santa Cruz Island in the Santa Barbara Channel off southern California (see Figure 1 in SIO's application). The seismic program will consist of grids of closely-spaced lines in each of 5 survey areas. Line spacing will be 100–400 m. There will be additional operations associated with equipment testing, startup, line changes, and repeat coverage of any areas where initial data quality is sub-standard. Water depths in the survey area range from <50 m to ~580 m. The seismic survey will be conducted in the territorial waters of the U.S., partly in California state waters.

At three deeper-water sites outside state waters, a small 45-in$^3$ GI airgun will be used, but will likely be reduced to 25- or 35-in$^3$. At two shallow-water sites that cross into California state waters, a 1.5-kJ electromechanical boomer or a 2-kJ electric sparker system will be used, depending on water depth and seafloor conditions, and depending on which source provides the highest resolution and best sub-seafloor signal penetration. The two systems will not operate concurrently and, in general, the boomer source likely will be preferred. As the boomer, sparker, or GI airgun are towed along the survey lines, a towed 72-channel, 450 m hydrophone streamer will receive the returning acoustic signals and transfer the data to the on-board processing system. Given the relatively short streamer length behind the vessel, the turning rate of the vessel while the gear is deployed is much higher than the limit of five degrees per minute for a seismic vessel towing a streamer of more typical length (>1 km). Thus, the maneuverability of the vessel is not limited much during operations.

In addition to the GI airgun, sparker, and boomer, a towed chirp system, a multibeam echosounder (MBES), and a sub-bottom profiler (SBP) will be used at various times during the cruise. The chirp system will be used in tandem with the seismic sources, or will be used separately to locate optimal piston core sites, up to 4 hours at a time to a maximum of 8–10 hours per day. A 3.5-kHz SBP will be used to help verify seafloor conditions at possible coring sites, and will also be used in tandem with a MBES during transit to and from the Santa Barbara Channel area to collect additional seafloor bathymetric data.

### *Vessel Specifications*

The *Melville* has a length of 85 m, a beam of 14.0 m, a maximum draft of 5.0 m, and can accommodate 23 crew and 86 scientists. Its gross tonnage is 2516 and is powered by two 1385-hp Propulsion General Electric motors and a 900-hp retracting Azimuthing bow thruster. The vessel will operate at a speed of ~7.4–8 km/h (4–4.3 knots) during seismic acquisition. When not towing seismic survey gear, the *Melville* cruises at 21.7 km/h (11.7 knots) and has a maximum speed of 25.9 km/h (14 knots). It has a normal operating range of approximately 18,630 km. The *Melville* will also serve as the platform from which vessel-based marine mammal observers will watch for marine mammals and sea turtles before and during airgun operations.

*Acoustic Source Specifications*

Seismic Airguns

The *Melville* will operate one small 45-in³ GI airgun but will likely reduce the chamber size to 25–35-in³. However, in case that is not possible, the specifications provided below are for a 45-in³ GI airgun (Table 1). Seismic pulses will be emitted at intervals of 3 seconds. At a vessel speed of approximately 4 knots (7.4 km/h), the 3-s spacing corresponds to a shot interval of approximately 6 m.

If possible, the generator chamber of the GI airgun, the one responsible for introducing the sound pulse into the ocean, will be set to 25 in³. The injector chamber also will be set to the same 25-in³ size and will inject air into the previously generated bubble to maintain its shape. This does not introduce more sound into the water. The airgun will be towed 21 m behind the *Melville* at a depth of 2 m. The variation of the sound pressure field of that GI-gun set to its original 45-in³ size and towed at a depth of 2.5 m has been modeled by L–DEO in relation to distance and direction from the GI airgun. At its reduced chamber size of 25 in³, these numbers will be further reduced. For comparison, the peak source sound level of the 45-in³ gun is 225.3 dB re 1 μ Pa, whereas the peak source sound level of a USGS GI airgun with chamber sizes reduced to 25 in³ is approximately 218 dB re 1 μPa·m. More information on characteristics of airgun sounds can be found in Appendix A in the SIO's EA.

TABLE 1—SPECIFICATIONS OF GI-AIRGUN PROPOSED TO BE USED DURING THE SIO SEISMIC SURVEY, NOVEMBER 2008

| GI-airgun specifications | |
|---|---|
| Energy source | GI airgun of 45 in³ or GI airgun of 25 in³ |
| Source output (downward) (45 in³) | 0-pk is 1.8 bar-m (225.3 dB re 1 μPa·mp); pk-pk is 3.4 bar-m (230.7 dB re 1 μPa·mp-p). |
| Source output (downward) (25 in³) | approx. 218 dB re 1 μPa·$m_p$. |
| Towing depth of energy source | 2 meters. |
| Air discharge volume | approx. 45 in³ or 25 in³. |
| Dominant frequency components | 0–188 Hz (45 in³) or <500 Hz (25 in³). |

**Electric Sparker**

The *Melville* will use a minisparker system similar to the SQUID 2000™ sparker system manufactured by Applied Acoustic Engineering, Inc. This minisparker includes electrodes mounted on a small pontoon sled that simultaneously discharge electric current through the seawater to an electrical ground, creating an electrical arc that momentarily vaporizes water between positive and negative leads. The collapsing bubbles produce an omnidirectional pulse. The pontoon sled that supports the minisparker is towed on the sea surface, approximately 5 m behind the ship.

Source characteristics of the SQUID 2000™ provided by the manufacturer show a source level of 209 dB re 1 $\mu Pa_{rms}$. This is at the full power level of 2 kJ. The power level of this source may be reduced to provide more consistent, reliable output signals if necessary. The amplitude spectrum of this pulse indicates that most of the sound energy lies between 150 Hz and 1700 Hz, and the peak amplitude is at 900 Hz. The output sound pulse of the minisparker has a duration of about 0.8 ms. When operated at sea for the proposed MCS-reflection survey, the minisparker will be discharged every 0.5–3 seconds.

**Electromechanical Boomer**

A boomer is a broad-band sound source operating in the 100–2500 Hz range. By sending electrical energy from the power supply through wire coils, spring-loaded plates in the boomer transducer are electrically charged causing the plates to repel, thus generating an acoustic pulse. The boomer planned for this cruise has three plates with a power input of 500 J per plate. The source level 219 dB re 1 μ $Pa_{peak}$; 209 dB re 1 $\mu Pa_{rms}$ and the boomer will be towed on the surface. When operated at sea for the proposed MCS-reflection survey, the boomer will be discharged every 0.5–2 seconds.

**Multibeam Echosounders and Sub-Bottom Profilers**

Along with the seismic operations, two additional acoustical data acquisition systems will be operated during part of the R/V *Melville's* cruise but only in transit, not during airgun use. The ocean floor will be mapped with the 12-kHz Simrad EM120 multi-beam echosounder (MBES) in transit to the survey area, and a 3.5-kHz sub-bottom profiler (SBP) will also be operated along with the MBES and also to help verify sea floor conditions at possible coring sites.

The *Melville* will operate a Kongsberg-Simrad EM120 Multi Beam Echo Sounder (MBES). The Kongsberg-Simrad EM120 operates at 11.25–12.6 kHz, and is mounted in the hull of the *Melville*. It operates in several modes, depending on water depth. In the proposed survey, it will be used in automatic mode, changing from ''Shallow'' to ''Medium'' mode at 450 m and from ''Medium'' to ''Deep'' mode at 1000 m. In ''Shallow'' mode, the beamwidth is 2° fore-aft and the estimated maximum source level is 232 dB re 1 $\mu Pa_{rms}$. Each ''ping'' consists of three successive fan-shaped transmissions, each 2 ms in duration with a delay of 3 ms between pulses for successive sectors. In ''Medium'' mode, the beamwidth is 1° or 2° fore-aft and the estimated maximum source levels are 232 or 226 dB re 1 $\mu Pa_{rms}$. Each ''ping'' consists of three successive fan-shaped transmissions, each 5 ms in duration with a delay of 6 ms between pulses for successive sectors. In ''Deep'' mode, the beamwidth is 1° or 2° fore-aft and the estimated maximum source levels are 239 or 233 dB re 1 $\mu Pa_{rms}$. Each ''ping'' consists of nine successive fan-shaped transmissions, each 15 ms in duration with a delay of 16 ms between pulses for successive sectors. The MBES will be used during transit to and from the Santa Barbara Channel area to collect additional sea floor bathymetric data.

In addition, an Edgetech 512i Chirp sub-bottom profiler (SBP) will also be a high resolution system that provides full-spectrum (''chirp'') imaging. The system is towed either at the water surface or slightly submerged, depending on the application and water depth. The 512i has a source level of 198 dB re 1 $\mu Pa_{rms}$. It has a frequency range of 500 Hz–12 kHz with pulse widths from 5 ms to 50 ms depending on the application. The chirp system will be used in tandem with the seismic sources, or will be used separately to locate optimal piston core sites, up to 4 hours at a time to a maximum of 8–10 hours per day.

*Safety Radii*

To aid in estimating the number of marine mammals that are likely to be taken, pursuant to the MMPA, and in developing effective mitigation measures, NMFS applies certain acoustic thresholds that indicate the received level at which Level A or Level B harassment would occur in marine mammals where exposed.

The distance from the sound source at which an animal would be exposed to these different received sound levels may be estimated and is typically referred to as safety radii. These safety radii are specifically used to help NMFS estimate the number of marine mammals likely to be harassed by the proposed activity and in deciding how close a marine mammal may approach an operating sound source before the applicant will be required to power-down or shut down the sound source.

**GI-Airguns**

NMFS has established a 160 dB re 1 $\mu Pa_{rms}$ behavioral harassment (Level B) threshold for both cetaceans and pinnipeds and a 190 dB and 180 dB re 1 $\mu Pa_{rms}$ threshold for the potential onset of injury (Level A) for pinnipeds and cetaceans, respectively. Received sound levels have been modeled by Lamont-Doherty Earth Observatory of Columbia University (L–DEO) for a number of airgun configurations, including one 45-in$^3$ GI airgun, in relation to distance and direction from the GI airgun. The model does not allow for bottom interactions, and is most directly applicable to deep water. Based on the modeling, estimates of the maximum distances from the GI airgun where sound levels of 190, 180, 160 dB re 1 $\mu Pa_{rms}$ are predicted to be received in deep (>1000-m) water are shown in Table 2. Because the model results are for a 2.5-m tow depth, which is deeper than the proposed 2-m tow depth, the distances in Table 2 slightly overestimate safety and harassment isopleth distances.

Empirical data concerning the 180- and 160-dB distances were acquired based on measurements during the acoustic verification study conducted by L–DEO in the northern Gulf of Mexico from 27 May to 3 June 2003 (Tolstoy *et al.* , 2004). Although the results are limited, the data show that radii around the airguns where the received level would be 180 dB re 1 $\mu Pa_{rms}$, the safety thresholds applicable to cetaceans (NMFS 2000), vary with water depth. Similar depth-related variation is likely in the 190-dB distances applicable to pinnipeds. Correction factors were developed for water depths 100–1000 m and <100 m. The empirical data indicate that, for deep water (>1000 m), the L–DEO model tends to overestimate the received sound levels at a given distance (Tolstoy *et al.* , 2004). However, to be precautionary pending acquisition of additional empirical data, it is proposed that safety radii during GI airgun operations in deep water will be the values predicted by L–DEO's model. Therefore, the assumed 190- and 180 dB re 1 µ Pa radii are 8 m and 23 m, respectively, and the 160 dB radius for this depth is 330 m (Table 2).

Empirical measurements were not conducted for intermediate depths (100–1000m). On the expectation that results will be intermediate between those from shallow and deep water, a 1.5x correction factor is applied to the estimates provided by the model for deep water situations. This is the same factor that was applied to the model estimates during L–DEO cruises in 2003. The assumed 190 and 180 dB re 1 µ Pa radii in intermediate-depth water are 12m and 35m, respectively, and the 160 dB radius for this depth is 220m (Table 2). Additional information regarding how the safety radii were calculated and how the empirical measurements were used to correct the modeled numbers may be found in the SIO application and EA. The proposed survey using the GI airgun will occur only in depths approximately 150–580m; therefore the 12m, 35m, and 330m radii are applicable.

TABLE 2—DISTANCES TO WHICH SOUND LEVELS ≥190, 180, AND 160 dB RE 1 $\mu PA_{rms}$ COULD BE RECEIVED FROM THE 45-IN$^3$ GI AIRGUN THAT WILL BE USED DURING THE SEISMIC SURVEYS IN THE SANTA BARBARA CHANNEL IN NOVEMBER 2008. DISTANCES ARE BASED ON MODEL RESULTS PROVIDED BY L–DEO

| Water depth | Estimated distances (m) at received levels | | |
|---|---|---|---|
| | 190 dB | 180 dB | 160 dB |
| >1000m | 8 | 23 | 220 |
| 100–1000m | 12 | 35 | 330 |

*Boomer/Sparker*

Either the boomer or the mini sparker will be used in State waters. The boomer likely will be used and its source level is higher than that of the mini sparker; therefore, the propagation distances for the boomer will be used. Received sound levels from the boomer proposed for use in shallow water have not been modeled or measured. However, Burgess and Lawson (2001) measured received sound levels from a boomer with a source level of 203 dB re 1 $\mu Pa_{rms}$ in water depths 12–14m, and Greene (2006) measured received sound levels from a boomer with a source level of 188.8 dB re 1 $\mu Pa_{rms}$ in water depths 37–48m, both in the Alaskan Beaufort Sea. The distances at which sound levels 190-, 180-, and 160-dB re 1 $\mu Pa_{rms}$ were received are given in Table 3 together with the distances predicted using a spherical spreading model. In each case, more so for the larger source level, the modeled distance exceeded the measured distance. As a conservative (i.e., precautionary) measure, the modeled distances will be used to calculation take estimates. The source level of the boomer is $_p$, corresponding roughly to 209 dB re 1 $\mu Pa{\cdot}m_{rms}$. Based on the spherical spreading model, distances to which sound levels ≥190, 180, 170, and 160 dB re 1 µParms could be received from the boomer are 9, 28, 90, and 280, respectively (Table 3).

TABLE 3—DISTANCES TO WHICH RECEIVED SOUND LEVELS ≥190, 180, AND 160 DB RE 1 μPA$_{rms}$ WERE MEASURED FOR TWO BOOMERS IN THE ALASKAN BEAUFORT SEA, AND DISTANCES PREDICTED BY A SPHERICAL SPREADING MODEL FOR THOSE SOURCES AND FOR THE BOOMER TO BE USED IN THE PROPOSED SURVEYS

| Boomer source level (dB re 1 μPa·mrms) and distance | Estimated distances (m) at received levels | | |
|---|---|---|---|
| | 190 dB | 180 dB | 160 dB |
| 203, measured | <1 | 2 | 22 |
| 203, modeled | 4.5 | 16 | 140 |
| 188.8, measured | 0.9 | 2.3 | 14.6 |
| 188.8, modeled | 1 | 2.7 | 27.5 |
| 209 (this study), modeled | 9 | 28 | 280 |

**Description of Marine Mammals in the Activity Area**

Thirty-two species of marine mammals, including 17 odontocetes, 8 mysticetes, 6 pinnipeds, and the southern sea otter (*Enhydra lutris*) could occur in the Santa Barbara Channel (SBC). In the U.S., sea otters are managed by the U.S. Fish and Wildlife Service (USFWS). The SIO is in the process of requesting consultation from the USFWS for impacts on sea otters; therefore, they will not be discussed further in this document. Of the 32 species, 20 are considered residents or regular visitors to the Channel Islands (CINMS), 14 of which are at least seasonally common to abundant in the SBC. The other 12 species are rare to extremely rare. Table 4 indicated relative abundance, density, habitat, status, and requested take for each species. Seven of the marine mammal species which could in the action area are endangered or threatened under the U.S. Endangered Species Act (ESA), including the North Pacific right whale (*Eubalaena japonica*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), blue whale (*Balenoptera musculus*), sperm whale (*Physeter macrocephalus*), and southern resident killer whales (*Orcinus orca*). However, not all these species are expected to be harassed from the proposed seismic survey due to rarity in the area and the small harassment isopleth distances. Table 4 below outlines the species by the requested number of takes by both instances and individuals. Number of exposed individuals and number of exposures are listed with respect to the 160dB re 1 μPa threshold. Cetaceans and pinnipeds would not be exposed to sound levels at or above 180 and 190 dB, respectively, due to implementation of mitigation measures (see Proposed Mitigation section). For more information on the status, distribution, and seasonal distribution of species or stocks of marine mammals which could be in the action area, please refer to SIO's application, section IV.

TABLE 4—THE OCCURRENCE, HABITAT, REGIONAL ABUNDANCE, CONSERVATION STATUS, BEST AND MAXIMUM DENSITY ESTIMATES, NUMBER OF MARINE MAMMALS THAT COULD BE EXPOSED TO SOUND LEVEL AT OR ABOVE 160DB RE 1μPA, BEST ESTIMATE OF NUMBER OF INDIVIDUALS EXPOSED, AND BEST ESTIMATE OF NUMBER OF EXPOSURES PER MARINE MAMMAL IN OR NEAR THE PROPOSED SEISMIC SURVEY AREA IN THE SANTA BARBARA CHANNEL (SBC). SEE TABLES 3–5 IN SIO'S APPLICATION FOR FURTHER DETAIL

| Species | Occurrence in SBC | Habitat | Abundance | ESA [1] | Density/ 1000km$^2$ (best) | Density/ 1000km$^2$ (max) | Number of individuals exposed | Number of exposures |
|---|---|---|---|---|---|---|---|---|
| North Pacific right whale. | Extremely rare; winter–spring vagrant. | Offshore, occasionally inshore. | 100–200 | EN | 0 | 0 | 0 | 0 |
| Gray whale | Common when migrating; rare Oct–Nov. | Coastal except near Channel Islands. | 18,813 | NL | 0 | 0 | 0 | 0 |
| Humpback whale | All year, common May–Jun, Sep–Dec. | Mainly nearshore waters and banks. | >6000 | EN | 0.22 | 0.33 | 0 | 0 |
| Minke whale | All year, common spring–fall. | Pelagic and coastal. | 9000 | NL | 0.36 | 0.54 | 0 | 0 |
| Bryde's whale | Rare | Pelagic and coastal. | 13,000 | NL | 0 | 0 | 0 | 0 |
| Sei whale | Very rare | Mostly pelagic | 7260–12,620 | EN | 0 | 0 | 0 | 0 |
| Fin whale | Uncommon all year. | Slope, mostly pelagic. | 13,620–18,680 | EN | 0.55 | 0.82 | 0 | 0 |
| Blue whale | All year, common Jun-–ct. | Pelagic and coastal. | 1186 | EN | 5.45 | 8.15 | 2 | 4 |
| Sperm whale | Uncommon all year. | Usually deep pelagic. | 24,000 | EN | 0.31 | 0.47 | 0 | 0 |
| Pygmy sperm whale. | Uncommon all year. | Deep waters off shelf. | N.A. | NL | 21.78 | 32.68 | 6 | 15 |
| Dwarf sperm whale. | Very rare | Deep waters off shelf. | 11,200 | NL | 0 | 0 | 0 | 0 |
| Cuvier's beaked whale. | Rare all year | Slope and pelagic. | 20,000 | NL | 1.44 | 2.16 | 1 | 1 |

TABLE 4—THE OCCURRENCE, HABITAT, REGIONAL ABUNDANCE, CONSERVATION STATUS, BEST AND MAXIMUM DENSITY ESTIMATES, NUMBER OF MARINE MAMMALS THAT COULD BE EXPOSED TO SOUND LEVEL AT OR ABOVE 160DB RE 1μPA, BEST ESTIMATE OF NUMBER OF INDIVIDUALS EXPOSED, AND BEST ESTIMATE OF NUMBER OF EXPOSURES PER MARINE MAMMAL IN OR NEAR THE PROPOSED SEISMIC SURVEY AREA IN THE SANTA BARBARA CHANNEL (SBC). SEE TABLES 3–5 IN SIO'S APPLICATION FOR FURTHER DETAIL—Continued

| Species | Occurrence in SBC | Habitat | Abundance | ESA [1] | Density/ 1000km² (best) | Density/ 1000km² (max) | Number of individuals exposed | Number of exposures |
|---|---|---|---|---|---|---|---|---|
| Baird's beaked whale. | Rare all year | Slope and pelagic. | 6000 | NL | 0 | 0 | 0 | 0 |
| Mesoplodon spp. beaked whale. | Rare all year | Slope and pelagic. | 1024 | NL | 0 | 0 | 0 | 0 |
| Offshore bottlenose dolphin. | Common all year | Offshore, slope, shelf. | 3257 | NL | 6.12 | 9.18 | 2 | 4 |
| Coastal bottlenose dolphin. | Common all year | Within 1 km of shore. | 323 | NL | 6.12 | 9.18 | 2 | 2 |
| Striped dolphin | Rare | Off continental shelf. | 1,824,000 | NL | 3.37 | 5.05 | 1 | 2 |
| Short-beaked common dolphin. | Common all year | Shelf, pelagic, high relief. | 487,622 | NL | 1364.41 | 2046.61 | 394 | 942 |
| Long-beaked common dolphin. | Common all year | Coastal, high relief. | 1893 | NL | 174.69 | 262.04 | 50 | 121 |
| Pacific white-sided dolphin. | All year, common fall–winter. | Offshore, slope | 931,000 | NL | 33 | 49.5 | 10 | 23 |
| Northern right whale dolphin. | Common only winter, spring. | Slope, offshore waters. | 15,305 | NL | 16.8 | 25.2 | 5 | 12 |
| Risso's dolphin | Common all year | Shelf, slope, seamounts. | 12,093 | NL | 18.35 | 27.53 | 5 | 13 |
| Killer whale | Uncommon all year. | Widely distributed. | 8500 | NL | 0 | 0 | 0 | 0 |
| Short-finned pilot whale. | Rare all year | Mostly pelagic, high-relief. | 160,200 | NL | 0 | 0 | 0 | 0 |
| Dall's porpoise | Uncommon all year. | Shelf, slope, offshore. | 57,549 | NL | 9.17 | 13.76 | 3 | 0 |
| Harbor porpoise | Rare | Coastal | 202,988 | NL | 0 | 0 | 0 | 0 |
| Guadalupe fur seal. | Extremely rare | Coastal | 7408 | T | N/A | N/A | 0 | 0 |
| Northern fur seal | Uncommon all year. | Pelagic, offshore | 721,935 | NL | N/A | N/A | 0 | 0 |
| California sea lion. | Common all year | Coastal, shelf | 238,000 | NL | 100 | 300 | 29 | 69 |
| Steller sea lion | Rare all year | Coastal, shelf | 44,584 | T | N/A | N/A | 0 | 0 |
| Harbor seal | Common all year | Coastal | 34,233 | NL | N/A | N/A | 0 | 0 |
| Northern elephant seal. | All year, common Dec–Mar peak. | Coastal, pelagic when migrating. | 124,000 | NL | N/A | N/A | 0 | 0 |

| Species | Occurrence in SBC | Habitat | Abundance | ESA [1] | Number of exposures [2] | Number of individuals exposed [3] | Requested take [4] |
|---|---|---|---|---|---|---|---|
| North Pacific right whale. | Extremely rare; winter–spring vagrant. | Offshore, occasionally inshore. | 100–200 | EN | 0 | 0 | 0 |
| Gray whale | Common when migrating; rare Oct–Nov. | Coastal except near Channel Islands. | 18,813 | NL | 0 | 0 | 0 |
| Humpback whale | All year, common May–Jun, Sep–Dec. | Mainly nearshore waters and banks. | >6000 | EN | 0 | 0 | 2 |
| Minke whale | All year, common spring–fall. | Pelagic and coastal | 9000 | NL | 0 | 0 | 0 |
| Bryde's whale | Rare | Pelagic and coastal | 13,000 | NL | 0 | 0 | 0 |
| Sei whale | Very rare | Mostly pelagic | 7260–12,620 | EN | 0 | 0 | 0 |
| Fin whale | Uncommon all year | Slope, mostly pelagic. | 13,620–18,680 | EN | 0 | 0 | 2 |
| Blue whale | All year, common Jun–Oct. | Pelagic and coastal | 1186 | EN | 4 | 2 | 2 |
| Sperm whale | Uncommon all year | Usually deep pelagic | 24,000 | EN | 0 | 0 | 8 |
| Pygmy sperm whale | Uncommon all year | Deep waters off shelf. | N.A. | NL | 15 | 6 | 9 |

| Species | Occurrence in SBC | Habitat | Abundance | ESA [1] | Number of exposures [2] | Number of individuals exposed [3] | Requested take [4] |
|---|---|---|---|---|---|---|---|
| Dwarf sperm whale | Very rare | Deep waters off shelf. | 11,200 | NL | 0 | 0 | 0 |
| Cuvier's beaked whale. | Rare all year | Slope and pelagic | 20,000 | NL | 1 | 1 | 1 |
| Baird's beaked whale. | Rare all year | Slope and pelagic | 6000 | NL | 0 | 0 | 0 |
| Mesoplodont beaked whale. | Rare all year | Slope and pelagic | 1024 | NL | 0 | 0 | 0 |
| Offshore bottlenose dolphin. | Common all year | Offshore, slope, shelf. | 3257 | NL | 4 | 2 | 3 |
| Coastal bottlenose dolphin. | Common all year | Within 1 km of shore | 323 | NL | 4 | 2 | 3 |
| Striped dolphin | Rare | Off continental shelf | 1,824,000 | NL | 2 | 1 | 1 |
| Short-beaked common dolphin. | Common all year | Shelf, pelagic, high relief. | 487,622 | NL | 942 | 394 | 591 |
| Long-beaked common dolphin. | Common all year | Coastal, high relief | 1893 | NL | 121 | 50 | 76 |
| Pacific white-sided dolphin. | All year, common fall–winter. | Offshore, slope | 931,000 | NL | 23 | 10 | 14 |
| Northern right whale dolphin. | Common only winter, spring. | Slope, offshore waters. | 15,305 | NL | 12 | 5 | 7 |
| Risso's dolphin | Common all year | Shelf, slope, seamounts. | 12,093 | NL | 13 | 5 | 8 |
| Killer whale | Uncommon all year | Widely distributed | 8500 | NL | 0 | 0 | 0 |
| Short-finned pilot whale. | Rare all year | Mostly pelagic, high-relief. | 160,200 | NL | 0 | 0 | 0 |
| Dall's porpoise | Uncommon all year | Shelf, slope, offshore. | 57,549 | NL | 0 | 3 | 4 |
| Harbor porpoise | Rare | Coastal | 202,988 | NL | 0 | 0 | 0 |
| Guadalupe fur seal | Extremely rare | Coastal | 7408 | T | 0 | 0 | 0 |
| Northern fur seal | Uncommon all year | Pelagic, offshore | 721,935 | NL | 0 | 0 | 0 |
| California sea lion | Common all year | Coastal, shelf | 238,000 | NL | 69 | 29 | 87 |
| Steller sea lion | Rare all year | Coastal, shelf | 44,584 | T | 0 | 0 | 0 |
| Harbor seal | Common all year | Coastal | 34,233 | NL | 0 | 0 | 20 |
| Northern elephant seal. | All year, common Dec–Mar peak. | Coastal, pelagic when migrating. | 124,000 | NL | 0 | 0 | 0 |

[1] U.S. Endangered Species Act: EN = Endangered, T = Threatened, NL = Not listed
[2] Best estimate as listed in Table 5 of the application
[3] Best estimate as listed in Table 5 of the application
[4] Requested number of takes as listed in Table 5 of application

**Potential Effects of the Proposed Activity on Marine Mammals**

*Potential Effects of Airgun Sounds on Marine Mammals*

The effects of sounds from airguns might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, temporary or permanent hearing impairment, or non-auditory physical or physiological effects (Richardson *et al.*, 1995; Gordon *et al.*, 2004; Nowacek *et al.*, 2007; Southall *et al.*, 2007). Given the small size of the GI gun planned for the present project, effects are anticipated to be considerably less than would be the case with a large array of airguns. It is very unlikely that there would be any cases of temporary or, especially, permanent hearing impairment or any significant non-auditory physical or physiological effects. Also, behavioral disturbance is expected to be limited to relatively short distances. Permanent hearing impairment, in the unlikely event that it occurred, would constitute injury, but temporary threshold shift (TTS) is not an injury (Southall *et al.*, 2007). With the possible exception of some cases of temporary threshold shift in harbor seals and perhaps some other seals, it is unlikely that the project would result in any cases of temporary or especially permanent hearing impairment, or any significant non-auditory physical or physiological effects. Some behavioral disturbance is expected, but is expected to be localized and short-term.

*Tolerance*

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. A summary of the characteristics of airgun pulses, is provided in Appendix A of NSF's EA prepared for this survey. Several studies have also shown that marine mammals at distances more than a few kilometers from operating seismic vessels often show no apparent response (tolerance) (see Appendix A of NSF's EA). That is often true even in cases when the pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times mammals of all three types have shown no overt reactions. In general, pinnipeds usually seem to be more tolerant of exposure to airgun pulses than cetaceans, with the relative responsiveness of baleen and toothed whales being variable.

*Masking*

Introduced underwater sound may, through masking, reduce the effective communication distance of a marine mammal species if the frequency of the source is close to that used as a signal by the marine mammal, and if the anthropogenic sound is present for a significant fraction of the time (Richardson *et al.*, 1995).

Masking effects of pulsed sounds (even from large arrays of airguns) on marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data on this. Because of the intermittent nature (one pulse every 105 or 210 seconds) and low duty cycle of seismic pulses, animals can emit and receive sounds in the relatively quiet intervals between pulses. However, in exceptional situations, reverberation occurs for much or all of the interval between pulses (e.g., Simard *et al.*, 2005; Clark and Gagnon, 2006) which could mask calls. Some baleen and toothed whales are known to continue calling in the presence of seismic pulses, and their calls can usually be heard between the seismic pulses (e.g., Richardson *et al.*, 1986; McDonald *et al.*, 1995; Greene *et al.*, 1999; Nieukirk *et al.*, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b, 2006). In the northeastern Pacific Ocean, blue whale calls have been recorded during a seismic survey off Oregon (McDonald *et al.*, 1995). Among odontocetes, there has been one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles *et al.*, 1994), but more recent studies found that they continued calling in the presence of seismic pulses (Madsen *et al.*, 2002c; Tyack *et al.*, 2003; Smultea *et al.*, 2004; Holst *et al.*, 2006; Jochens *et al.*, 2006). Dolphins and porpoises commonly are heard calling while airguns are operating (e.g., Gordon *et al.*, 2004; Smultea *et al.*, 2004; Holst *et al.*, 2005a,b; Potter *et al.*, 2007). The sounds important to small odontocetes are predominantly at much higher frequencies than are the dominant components of airgun sounds, thus limiting the potential for masking. In general, masking effects of seismic pulses are expected to be minor, given the normally intermittent nature of seismic pulses and the Melville being the only seismic vessel operating in the area for a limited time. Masking effects on marine mammals are discussed further in Appendix A of NSF's EA.

*Disturbance Reactions*

Disturbance includes a variety of effects, including subtle to conspicuous changes in behavior, movement, and displacement. Based on NMFS (2001, p. 9293), NRC (2005), and Southall *et al.* (2007), it is assumed that simple exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking," with "potentially significant" meaning "in a manner that might have deleterious effects to the well-being of individual marine mammals or their populations".

Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson *et al.*, 1995; Wartzok *et al.*, 2004; Southall *et al.*, 2007). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant. Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many mammals would be present within a particular distance of industrial activities and exposed to a particular level of industrial sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically-important manner.

The sound criteria used to estimate how many marine mammals might be disturbed to some biologically-important degree by a seismic program are based primarily on behavioral observations of a few species. Detailed studies have been done on humpback, gray, bowhead (*Balaena mysticetus*), and sperm whales, and on ringed seals (*Pusa hispida*). Less detailed data are available for some other species of baleen whales, small toothed whales, and sea otters, but for many species there are no data on responses to marine seismic surveys.

*Baleen Whales*

Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, as reviewed in SIO's application and Appendix A of NSF's EA, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding and moving away. In the cases of migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals. They simply avoided the sound source by displacing their migration route to varying degrees, but within the natural boundaries of the migration corridors.

Studies of gray, bowhead, and humpback whales have shown that seismic pulses with received levels of 160–170 dB re 1 μPa (rms) seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed (Richardson *et al.*, 1995). In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 4–15 km (2.5–9.3 mi) from the source. A substantial proportion of the baleen whales within those distances may show avoidance or other strong behavioral reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and studies, summarized in Appendix A(5) of SIO's EA, have shown that some species of baleen whales, notably bowhead and humpback whales, at times show strong avoidance at received levels lower than 160–170 dB re 1 μPa (rms).

Responses of humpback whales to seismic surveys have been studied during migration, on summer feeding grounds, and on Angolan winter breeding grounds; there has also been discussion of effects on the Brazilian wintering grounds. McCauley *et al.* (1998, 2000a) studied the responses of humpback whales off Western Australia to a full-scale seismic survey with a 16-airgun, 2678-in$^3$ array, and to a single 20-in$^3$ airgun with source level 227 dB re 1 μPa · m (peak to peak). McCauley *et al.* (1998) documented that avoidance reactions began at 5–8 km (3–5 mi) from the array, and that those reactions kept most pods approximately 3–4 km (1.8–2.5 mi) from the operating seismic boat. McCauley *et al.* (2000a) noted localized displacement during migration of 4–5 km (2.5–3.1 mi) by traveling pods and 7–12 km (4.3–7.5 mi) by more sensitive resting pods of cow-calf pairs. Avoidance distances with respect to the single airgun were smaller but consistent with the results from the full array in terms of the received sound levels. The mean received level for initial avoidance of an approaching airgun was 140 dB re 1 μPa (rms) for humpback pods containing females, and at the mean closest point of approach distance the received level was 143 dB re 1 μPa (rms). The initial avoidance response generally occurred at distances of 5–8 km (3.1–4.9 mi) from the airgun array and 2 km (1.2 mi) from the single airgun. However, some individual humpback whales, especially males, approached within distances of 100–400 m (328–1312 ft), where the maximum received level was 179 dB re 1 μPa (rms).

Humpback whales on their summer feeding grounds in southeast Alaska did not exhibit persistent avoidance when exposed to seismic pulses from a 1.64-L (100-in$^3$) airgun (Malme *et al.*, 1985). Malme *et al.* reported that some of the humpbacks seemed startled at received levels of 150–169 dB re 1 μPa and concluded that there was no clear evidence of avoidance, despite the possibility of subtle effects, at received levels up to 172 re 1 μPa on an approximate rms basis. It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even strand upon exposure to seismic surveys (Engel *et al.*, 2004). The evidence for this was circumstantial and subject to alternative explanations (IAGC, 2004). Also, the evidence was not consistent with subsequent results from the same area of Brazil (Parente *et al.*, 2006), or with direct studies of humpbacks exposed to seismic surveys in other areas and seasons. After allowance for data from subsequent years, there was ''no observable direct correlation'' between strandings and seismic surveys (IWC, 2007:236).

There are no data on reactions of right whales to seismic surveys, but results from the closely-related bowhead whale show that their responsiveness can be quite variable depending on their activity (migrating versus feeding). Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with substantial avoidance occurring out to distances of 20–30 km from a medium-sized airgun source at received sound levels of around 120–130 dB re 1 μPa (rms) (Miller *et al.*, 1999; Richardson *et al.*, 1999). However, more recent research on bowhead whales (Miller *et al.*, 2005; Harris *et al.*, 2007) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. Nonetheless, subtle but statistically significant changes in surfacing-respiration-dive cycles were evident upon statistical analysis (Richardson *et al.*, 1986). In summer, bowheads typically begin to show avoidance reactions at received levels of about 152–178 dB re 1 μPa (rms) (Richardson *et al.*, 1986, 1995; Ljungblad *et al.*, 1988; Miller *et al.*, 2005).

Reactions of migrating and feeding (but not wintering) gray whales to seismic surveys have been studied. Malme *et al.* (1986, 1988) studied the responses of feeding eastern Pacific gray whales to pulses from a single 100-in$^3$ airgun off St. Lawrence Island in the northern Bering Sea. They estimated, based on small sample sizes, that 50 percent of feeding gray whales stopped feeding at an average received pressure level of 173 dB re 1 μPa on an (approximate) rms basis, and that 10 percent of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa (rms). Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast (Malme *et al.*, 1984; Malme and Miles, 1985), and western Pacific gray whales feeding off Sakhalin Island, Russia (Wursig *et al.*, 1999; Gailey *et al.*, 2007; Johnson *et al.*, 2007; Yazvenko *et al.*, 2007a, b), along with data on gray whales off British Columbia (Bain and Williams, 2006).

Various species of *Balaenoptera* (blue, sei, fin, and minke whales) have occasionally been reported in areas ensonified by airgun pulses (Stone, 2003; MacLean and Haley, 2004; Stone and Tasker, 2006). Sightings by observers on seismic vessels off the United Kingdom from 1997 to 2000 suggest that, during times of good sightability, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting vs. silent (Stone, 2003; Stone and Tasker, 2006). However, these whales tended to exhibit localized avoidance, remaining significantly further (on average) from the airgun array during seismic operations compared with non-seismic periods (Stone and Tasker, 2006). In a study off Nova Scotia, Moulton and Miller (2005) found little difference in sighting rates (after accounting for water depth) and initial sighting distances of balaenopterid whales when airguns were operating versus silent. However, there were indications that these whales were more likely to be moving away when seen during airgun operations. Similarly, ship-based monitoring studies of blue, fin, sei and minke whales offshore of Newfoundland (Orphan Basin and Laurentian Sub-basin) found no more than small differences in sighting rates and swim directions during seismic vs. non-seismic periods Moulton *et al.*, 2005, 2006a,b).

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades (Appendix A *in* Malme *et al.*, 1984; Richardson *et al.*, 1995; Angliss and Outlaw, 2008). The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year (Johnson *et al.*, 2007). Similarly, bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably, despite seismic exploration in their summer and autumn range for many years (Richardson *et al.*, 1987; Angliss and Outlaw, 2008).

*Toothed Whales*

Little systematic information is available about reactions of toothed whales to noise pulses. Few studies similar to the more extensive baleen whale/seismic pulse work summarized above and (in more detail) in Appendix A of SIO's application have been reported for toothed whales. However, there are recent systematic studies on sperm whales (Jochens *et al.*, 2006; Miller *et al.*, 2006), and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Stone, 2003; Smultea *et al.*, 2004; Moulton and Miller, 2005; Bain and Williams, 2006; Holst *et al.*, 2006; Stone and Tasker, 2006; Potter *et al.*, 2007; Weir, 2008).

Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels (e.g., Goold, 1996a,b,c; Calambokidis and Osmek, 1998; Stone, 2003; Moulton and Miller, 2005; Holst *et al.*, 2006; Stone and Tasker, 2006; Weir, 2008). Some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing (e.g., Moulton and Miller, 2005). Nonetheless, small toothed whales more often tend to head away, or to maintain a somewhat greater distance from the vessel, when a large array of airguns is operating than when it is silent (e.g., Stone and Tasker, 2006; Weir, 2008). In most cases the avoidance radii for delphinids appear to be small, on the order of 1 km less, and some individuals show no apparent avoidance. The beluga (*Delphinapterus leucas*) is a species that (at least at times) shows long-distance avoidance of seismic vessels. Aerial surveys conducted in the southeastern Beaufort Sea during summer found that sighting rates of beluga whales were significantly lower at distances 10–20 km (6.2–12.4 mi) compared with 20–30 km (12.4–18.6 mi) from an operating airgun array, and observers on seismic boats in that area rarely see belugas (Miller *et al.*, 2005; Harris *et al.*, 2007).

Captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran *et al.*, 2000, 2002, 2005). However, the animals tolerated high received levels of sound before exhibiting aversive behaviors.

Results for porpoises depend on species. The limited available data suggest that harbor porpoises show stronger avoidance of seismic operations than do Dall's porpoises (Stone, 2003; MacLean and Koski, 2005; Bain and Williams, 2006; Stone and Tasker, 2006). Dall's porpoises seem relatively tolerant of airgun operations (MacLean and Koski, 2005; Bain and Williams, 2006), although they too have been observed to avoid large arrays of operating airguns (Calambokidis and Osmek, 1998; Bain and Williams, 2006). This apparent difference in responsiveness of these two porpoise species is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson *et al.*, 1995; Southall *et al.*, 2007).

Most studies of sperm whales exposed to airgun sounds indicate that the sperm whale shows considerable tolerance of airgun pulses (e.g., Stone, 2003; Moulton *et al.*, 2005, 2006a; Stone and Tasker, 2006; Weir, 2008). In most cases the whales do not show strong avoidance, and they continue to call (see Appendix A of NSF's EA for review). However, controlled exposure experiments in the Gulf of Mexico indicate that foraging behavior was altered upon exposure to airgun sound (Jochens *et al.*, 2006).

There are almost no specific data on the behavioral reactions of beaked whales to seismic surveys. However, northern bottlenose whales (*Hyperoodon ampullatus*) continued to produce high-frequency clicks when exposed to sound pulses from distant seismic surveys (Laurinolli and Cochrane, 2005; Simard *et al.*, 2005). Most beaked whales tend to avoid approaching vessels of other types (e.g., Wursig *et al.*, 1998). They may also dive for an extended period when approached by a vessel (e.g., Kasuya, 1986). Thus, it is likely that beaked whales would also show strong avoidance of an approaching seismic vessel, although this has not been documented explicitly.

There are increasing indications that some beaked whales tend to strand when naval exercises involving mid-frequency sonar operation are ongoing nearby (e.g., Simmonds and Lopez-Jurado, 1991; Frantzis, 1998; NOAA and USN, 2001; Jepson *et al.*, 2003; Hildebrand, 2005; Barlow and Gisiner, 2006; see also the ''Strandings and Mortality'' subsection, later). These strandings are apparently at least in part a disturbance response, although auditory or other injuries or other physiological effects may also be a involved. Whether beaked whales would ever react similarly to seismic surveys is unknown (see ''Strandings and Mortality'', below). Seismic survey sounds are quite different from those of the sonar in operation during the above-cited incidents.

Odontocete reactions to large arrays of airguns are variable and, at least for delphinids and Dall's porpoises, seem to be confined to a smaller radius than has been observed for the more responsive of the mysticetes, belugas, and harbor porpoises (refer to Appendix A in NSF's EA). NMFS has established a 160 dB re 1 μPa disturbance threshold. Animals exposed to received sound levels at or above this threshold (but below injurious threshold) shall be considered ''taken'' by behavioral harassment (Level B).

*Pinnipeds*

Pinnipeds are not likely to show a strong avoidance reaction to the airgun array. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds, and only slight (if any) changes in behavior (Appendix A in NSF's EA). In the Beaufort Sea, some ringed seals avoided an area of 100 m (328 ft) to (at most) a few hundred meters around seismic vessels, but many seals remained within 100–200 m (328–656 ft) of the trackline as the operating airgun array passed by (e.g., Harris *et al.*, 2001; Moulton and Lawson, 2002; Miller *et al.*, 2005). Ringed seal sightings averaged somewhat farther away from the seismic vessel when the airguns were operating than when they were not, but the difference was small (Moulton and Lawson, 2002). Similarly, in Puget Sound, sighting distances for harbor seals and California sea lions tended to be larger when airguns were operating (Calambokidis and Osmek, 1998). Previous telemetry work suggests that avoidance and other behavioral reactions may be stronger than evident to date from visual studies (Thompson *et al.*, 1998). Even if reactions of any pinnipeds that might be encountered in the present study area are as strong as those evident in the telemetry study, reactions are expected to be confined to relatively small distances and durations, with no long-term effects on pinniped individuals or populations. As for cetaceans, the 160 dB or above disturbance threshold, but below injurious levels (190 dB), is considered appropriate for pinnipeds.

*Hearing Impairment and Other Physical Effects*

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds, and temporary threshold shift (TTS) has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds (reviewed in Southall *et al.*, 2007). However, there has been no specific documentation of TTS let alone permanent hearing damage, i.e., permanent threshold shift (PTS), in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions. Current NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds with received levels of 180 and 190 dB re 1 $\mu Pa_{rms}$ or above, respectively, are considered to have been taken incidentally taken by Level A harassment. (NMFS, 2000). These levels are precautionary and were used in establishing the exclusion (i.e., shut-down) zones planned for the proposed seismic survey.

Several aspects of the planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the airgun array, and to avoid exposing them to sound pulses that might, at least in theory, cause hearing impairment. In addition, many cetaceans and (to a limited degree) pinnipeds and sea turtles are likely to show some avoidance or the area with high received levels of airgun sound. In those cases, the avoidance responses of the animals themselves will reduce or (most likely) avoid any possibility of hearing impairment.

Non-auditory physical effects might also occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that might (in theory) occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds. However, as discussed below, there is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns. It is unlikely that any effects of these types would occur during the proposed project given the brief duration of exposure of any given mammal, the deep water in the survey area, and the planned monitoring and mitigation measures (see below). The following subsections discuss in somewhat more detail the possibilities of TTS, PTS, and non-auditory physical effects.

*Temporary Threshold Shift (TTS)*

TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days. For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the noise ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in Southall *et al.* (2007).

For toothed whales exposed to single short pulses, the TTS threshold appears to be, to a first approximation, a function of the energy content of the pulse (Finneran *et al.*, 2002, 2005). Sound exposure level (SEL), which takes into account the duration of the sound, is the metric used to measure energy and uses the units dB re 1 $\mu Pa^2 \cdot s$, as opposed to sound pressure level (SPL), which is the pressure metric used in the rest of this document (units—dB re 1 µPa). Given the available data, the received energy level of a single seismic pulse (with no frequency weighting) might need to be approximately 186 dB re 1 µPa2 · s, (i.e., 186 dB SEL or approximately 196–201 dB re 1 $\mu Pa_{rms}$) in order to produce brief, mild TTS. Exposure to several strong seismic pulses that each have received levels near 190 dB re 1 $\mu Pa_{rms}$ might result in cumulative exposure of approximately 186 dB SEL and thus slight TTS in a small odontocete, assuming the TTS threshold is (to a first approximation) a function of the total received pulse energy. The distances from the *Melville's* single airgun at which the received energy level (per pulse, flat-weighted) would be expected to be 190 dB re 1 $\mu Pa_{rms}$ or above, are shown in Table 2. Levels 190 dB re 1 $\mu Pa_{rms}$ or above are expected to be restricted to radii no more than 12m (39 ft) (Table 2) from the airgun at full chamber size (45 $in^3$). Again, this is a conservative safety zone since the applicant has indicated the airgun will likely be operated at 25–35 $in^3$. For an odontocete closer to the surface, the maximum radius with 190 dB re 1 $\mu Pa_{rms}$ or above, would be smaller.

The above TTS information for odontocetes is derived from studies on the bottlenose dolphin and beluga. There is no published TTS information for other types of cetaceans. However, preliminary evidence from a harbor porpoise exposed to airgun sound suggests that its TTS threshold may have been lower (Lucke *et al.*, 2007).

For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. The frequencies to which baleen whales are most sensitive are assumed to be lower than those to which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison, 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales (Southall *et al.*, 2007). In any event, no cases of TTS are expected given three considerations: (1) The low abundance of baleen whales in most parts of the planned study area; (2) the strong likelihood that baleen whales would avoid the approaching airgun (or vessel) before being exposed to levels high enough for TTS to occur; and (3) the mitigation measures that are planned.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from more prolonged (non-pulse) exposures suggested that some pinnipeds (harbor seals in particular) incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak *et al.*, 1999, 2005; Ketten *et al.*, 2001). The pinniped TTS threshold for pulsed sounds has been indirectly estimated as being a SEL of approximately 171 dB re 1 $\mu Pa^2 \cdot s$, (Southall *et al.*, 2007), which would be equivalent to a single pulse with received level of approximately 181–186 dB re 1 $\mu Pa_{rms}$, or a series of pulses for which the highest rms values are a few dB lower.

*Permanent Threshold Shift (PTS)*

When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, while in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985). There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the possibility that mammals close to an airgun array might incur at least mild TTS, there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (Richardson *et al.*, 1995, p. 372*ff*). Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage. Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals. PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise time—see Appendix A of NSF's EA. Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as airgun pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis, and probably greater than 6 dB (Southall *et al.*, 2007). On an SEL basis, Southall *et al.* (2007:441–4) estimated that received levels would need to exceed the TTS threshold by at least 15 dB for there to be risk of PTS. Thus, for cetaceans, they estimate that the PTS threshold might be an mammal-weighted (M-weighted) SEL (for the sequence of received pulses) of approximately 198 dB re 1 $\mu Pa^2 \cdot s$, (15 dB higher than the TTS threshold for an impulse), where the SEL value is accumulated over the sequence of pulses. Additional assumptions had to be made to derive a corresponding estimate for pinnipeds, as the only available data on TTS-thresholds in pinnipeds pertain to non-impulse sound. Southall *et al.* (2007) estimate that the PTS threshold could be a cumulative $M_{pw}$-weighted SEL of approximately 186 dB re 1 $\mu Pa^2 \cdot s$, in the harbor seal exposed to impulse sound. The PTS threshold for the California sea lion and northern elephant seal, the PTS threshold would probably be higher, given the higher TTS thresholds in those species.

Southall *et al.* (2007) also note that, regardless of the SEL, there is concern about the possibility of PTS if a cetacean or pinniped received one or more pulses with peak pressure exceeding 230 or 218 dB re 1µPa (peak), respectively. A peak pressure of 230 dB re 1µPa (3.2 bar · m, 0-peak) would only be found within a few meters of the largest (360 in$^3$) airgun in the planned airgun array (Caldwell and Dragoset, 2000). A peak pressure of 218 dB re 1 µPa could be received somewhat farther away; to estimate that specific distance, one would need to apply a model that accurately calculates peak pressures in the nearfield around an array of airguns.

Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS would occur. Baleen whales generally avoid the immediate area around operating seismic vessels, as do some other marine mammals and sea turtles. The planned monitoring and mitigation measures, including visual monitoring, PAM, power downs, and shut downs of the airguns when mammals are seen within or approaching the exclusion zones, will further reduce the probability of exposure of marine mammals to sounds strong enough to induce PTS.

*Non-Auditory Physiological Effects*

Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance, and other types of organ or tissue damage (Cox *et al.*, 2006; Southall *et al.*, 2007). Studies examining such effects are limited. However, resonance (Gentry, 2002) and direct noise-induced bubble formation (Crum *et al.*, 2005) are not expected in the case of an impulsive source like an airgun array. If seismic surveys disrupt diving patterns of deep-diving species, this might perhaps result in bubble formation and a form of the bends, as speculated to occur in beaked whales exposed to sonar. However, there is no specific evidence of this upon exposure to airgun pulses.

In general, very little is known about the potential for seismic survey sounds (or other types of strong underwater sounds) to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.*, 2007), or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales, some odontocetes, and some pinnipeds, are especially unlikely to incur non-auditory physical effects. Also, the planned mitigation measures, including shut downs of the airguns, will reduce any such effects that might otherwise occur.

*Strandings and Mortality*

Marine mammals close to underwater detonations of high explosives can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten *et al.*, 1993; Ketten, 1995). However, explosives are no longer used for marine seismic research or commercial seismic surveys, and have been replaced entirely by airguns or related non-explosive pulse generators. Airgun pulses are less energetic and have slower rise times, and there is no specific evidence that they can cause serious injury, death, or stranding even in the case of large airgun arrays. However, the association of mass strandings of beaked whales with naval exercises and, in one case, an L–DEO seismic survey (Malakoff, 2002; Cox *et al.*, 2006), has raised the possibility that beaked whales exposed to strong pulsed sounds may be especially susceptible to injury and/or behavioral reactions that can lead to stranding (*e.g.*, Hildebrand, 2005; Southall *et al.*, 2007).

Specific sound-related processes that lead to strandings and mortality are not well documented, but may include: (1) Swimming in avoidance of a sound into shallow water; (2) a change in behavior (such as a change in diving behavior) that might contribute to tissue damage, gas bubble formation, hypoxia, cardiac arrhythmia, hypertensive hemorrhage or other forms of trauma; (3) a physiological change such as a vestibular response leading to a behavioral change or stress-induced hemorrhagic diathesis, leading in turn to tissue damage; and (4) tissue damage directly from sound exposure, such as through acoustically mediated bubble formation and growth or acoustic resonance of tissues. There are increasing indications that gas-bubble disease (analogous to the bends), induced in supersaturated tissue by a behavioral response to acoustic exposure, could be a pathologic mechanism for the strandings and mortality of some deep-diving cetaceans exposed to sonar. However, the evidence for this remains circumstantial and associated with exposure to naval mid-frequency sonar, not seismic surveys (Cox *et al.*, 2006; Southall *et al.*, 2007).

Seismic pulses and mid-frequency sonar signals are quite different, and some mechanisms by which sonar sounds have been hypothesized to affect beaked whales are unlikely to apply to airgun pulses. Sounds produced by airgun arrays are broadband impulses with most of the energy below 1 kHz. Typical military mid-frequency sonars emit non-impulse sounds at frequencies of 2–10 kHz, generally with a relatively narrow bandwidth at any one time. A further difference between seismic surveys and naval exercises is that naval exercises can involve sound sources on more than one vessel. Thus, it is not appropriate to assume that there is a direct connection between the effects of military sonar and seismic surveys on marine mammals. However, evidence that sonar signals can, in special circumstances, lead (at least indirectly) to physical damage and mortality (*e.g.*, Balcomb and Claridge, 2001; NOAA and USN, 2001; Jepson *et al.*, 2003; Fernandez *et al.*, 2004, 2005; Hildebrand, 2005; Cox *et al.*, 2006) suggests that caution is warranted when dealing with exposure of marine mammals to any high-intensity pulsed sound.

There is no conclusive evidence of cetacean strandings or deaths at sea as a result of exposure to seismic surveys, but a few cases of strandings in the general area where a seismic survey was ongoing have led to speculation concerning a possible link between seismic surveys and strandings. Suggestions that there was a link between seismic surveys and strandings of humpback whales in Brazil (Engel *et al.*, 2004) were not well founded (IAGC, 2004; IWC, 2007). In September 2002, there was a stranding of two Cuvier's beaked whales (*Ziphius cavirostris* ) in the Gulf of California, Mexico, when the L–DEO vessel R/V *Maurice Ewing* was operating a 20-airgun, 8490-in$^3$ airgun array in the general area. The link between the stranding and the seismic surveys was inconclusive and not based on any physical evidence (Hogarth, 2002; Yoder, 2002). Nonetheless, the Gulf of California incident plus the beaked whale strandings near naval exercises involving use of mid-frequency sonar suggests a need for caution in conducting seismic surveys in areas occupied by beaked whales until more is known about effects of seismic surveys on those species (Hildebrand, 2005). No injuries of beaked whales are anticipated during the proposed study because of: (1) The high likelihood that any beaked whales nearby would avoid the approaching vessel before being exposed to high sound levels; (2) the proposed monitoring and mitigation measures; (3) the use of a single, low-energy airgun; and (4) differences between the sound sources operated by SIO and those involved in the naval exercises associated with strandings.

**Potential Effects of Other Acoustic Devices**

*Multibeam Echosounder (MBES) Signals*

The Simrad EM120 12-kHz MBES will be operated from the source vessel at some times during the planned study. Sounds from the MBES are very short pulses, occurring for 2–15 ms once every 5–20 s, depending on water depth. Most of the energy in the sound pulses emitted by this MBES is at frequencies near 12 kHz, and the maximum source level is 242 dB re 1 $\mu Pa_{rms}$. The beam is very narrow (1 degree) in fore-aft extent and wide (150 degrees) in the cross-track extent. Each ping consists of nine successive fan-shaped transmissions (segments) at different cross-track angles. Any given mammal at depth near the trackline would be in the main beam for only one or two of the nine segments. Also, marine mammals that encounter the Simrad EM120 are unlikely to be subjected to repeated pulses because of the narrow fore-aft width of the beam and will receive only limited amounts of pulse energy because of the short pulses. Animals close to the ship (where the beam is narrowest) are especially unlikely to be ensonified for more than one 2–15 ms pulse (or two pulses if in the overlap area). Similarly, Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when an MBES emits a pulse is small. The animal would have to pass the transducer at close range and be swimming at speeds similar to the vessel in order to receive the multiple pulses that might result in sufficient exposure to cause TTS.

Navy sonars that have been linked to avoidance reactions and stranding of cetaceans (1) generally have a longer pulse duration than the Simrad EM120, and (2) are often directed close to omnidirectionally versus more downward for the Simrad EM120. The area of possible influence of the MBES is much smaller—a narrow band below the source vessel. The duration of exposure for a given marine mammal can be much longer for naval sonar. During SIO's operations, the individual pulses will be very short, and a given mammal would not receive many of the downward-directed pulses as the vessel passes by. Possible effects of an MBES on marine mammals are outlined below.

*Masking*

Marine mammal communications will not be masked appreciably by the MBES signals given the low duty cycle of the echosounder and the brief period when an individual mammal is likely to be within its beam. Furthermore, in the case of baleen whales, the MBES signals (12 kHz) do not overlap with the predominant frequencies in the calls, which would avoid any significant masking.

*Behavioral Responses*

Behavioral reactions of free-ranging marine mammals to sonar, echosounders, and other sound sources appear to vary by species and circumstance. Observed reactions have included silencing and dispersal by sperm whales (Watkins *et al.*, 1985), increased vocalizations and no dispersal by pilot whales (Rendell and Gordon, 1999), and the previously-mentioned beachings by beaked whales. During exposure to a 21–25 kHz sonar with a source level of 215 dB re 1μPa, gray whales reacted by orienting slightly away from the source and being deflected from their course by approximately 200 m (Frankel, 2005). When a 38-kHz echosounder and a 150-kHz acoustic Doppler current profiler were transmitting during studies in the Eastern Tropical Pacific, baleen whales showed no significant responses, while spotted and spinner dolphins were detected slightly more often and beaked whales less often during visual surveys (Gerrodette and Pettis, 2005).

Captive bottlenose dolphins and a white whale exhibited changes in behavior when exposed to 1-s tonal signals at frequencies similar to those that will be emitted by the MBES used by SIO, and to shorter broadband pulsed signals. Behavioral changes typically involved what appeared to be deliberate attempts to avoid the sound exposure (Schlundt *et al.*, 2000; Finneran *et al.*, 2002; Finneran and Schlundt 2004). The relevance of those data to free-ranging odontocetes is uncertain, and in any case, the test sounds were quite different in duration as compared with those from an MBES.

Very few data are available on the reactions of pinnipeds to sonar sounds at frequencies similar to those used during seismic operations. Hastie and Janik (2007) conducted a series of behavioral response tests on two captive gray seals to determine their reactions to underwater operation of a 375-kHz multibeam imaging sonar that included significant signal components down to 6 kHz. Results indicated that the two seals reacted to the sonar signal by significantly increasing their dive durations. Because of the likely brevity of exposure to the MBES sounds, pinniped reactions are expected to be limited to startle or otherwise brief responses of no lasting consequence to the animals.

*Hearing Impairments and Other Physical Effects*

Given recent stranding events that have been associated with the operation of naval sonar, there is concern that mid-frequency sonar sounds can cause serious impacts to marine mammals (see above). However, the MBES proposed for use by SIO is quite different than sonar used for navy operations. Pulse duration of the MBES is very short relative to the naval sonar. Also, at any given location, an individual marine mammal would be in the beam of the MBES for much less time given the generally downward orientation of the beam and its narrow fore-aft beamwidth; navy sonars often use near-horizontally-directed sound. Those factors would all reduce the sound energy received from the MBES rather drastically relative to that from the sonar used by the navy.

Given the maximum source level of 242 dB re 1 $\mu Pa_{rms}$ (see § I), the received level for an animal within the MBES beam 100 m below the ship would be approximately 202 dB re 1 $\mu Pa_{rms}$, assuming 40 dB of spreading loss over 100 m (circular spreading). Given the narrow beam, only one pulse is likely to be received by a given animal as the ship passes overhead. The received energy level from a single pulse of duration 15 ms would be about 184 dB re 1 $\mu Pa^2 \cdot s$, i.e., 202 dB + 10 log (0.015 s). That is below the TTS threshold for a cetacean receiving a single non-impulse sound (195 dB re 1 $\mu Pa^2 \cdot s$) and even further below the anticipated PTS threshold (215 dB re 1 $\mu Pa^2 \cdot s$) (Southall *et al.*, 2007). In contrast, an animal that was only 10 m below the MBES when a ping is emitted would be expected to receive a level ~20 dB higher, i.e., 204 dB re 1 $\mu Pa^2 \cdot s$ in the case of the EM120. That animal might incur some TTS (which would be fully recoverable), but the exposure would still be below the anticipated PTS threshold for cetaceans. As noted by Burkhardt *et al.* (2007, 2008), cetaceans are very unlikely to incur PTS from operation of scientific sonars on a ship that is underway.

In the harbor seal, the TTS threshold for non-impulse sounds is about 183 dB re 1 $\mu Pa^2 \cdot s$, as compared with ~195 dB re 1 $\mu Pa^2 \cdot s$ in odontocetes (Kastak *et* *al.*, 2005; Southall *et al.*, 2007). TTS onset occurs at higher received energy levels in the California sea lion and northern elephant seal than in the harbor seal. A harbor seal as much as 100 m below the *Melville* could receive a single MBES pulse with received energy level of ≥184 dB re 1 μPa² · s (as calculated in the toothed whale subsection above) and thus could incur slight TTS. Species of pinnipeds with higher TTS thresholds would not incur TTS unless they were closer to the transducers when a sonar ping was emitted. However, the SEL threshold for PTS in pinnipeds (203 dB re 1 μPa² · s) might be exceeded for a ping received within a few meters of the transducers, although the risk of PTS is higher for certain species (e.g., harbor seal). Given the intermittent nature of the signals and the narrow MBES beam, only a small fraction of the pinnipeds below (and close to) the ship would receive a pulse as the ship passed overhead.

*Sub-Bottom Profiler Signals*

An SBP may be operated from the source vessel at times during the planned study. Sounds from the sub-bottom profiler are very short pulses, occurring for 1–4 ms once every second. Most of the energy in the sound pulses emitted by the SBP is at 3.5 kHz, and the beam is directed downward in a narrow beam with a spacing of up to 15 degrees and a fan width up to 30 degrees. The Edgetech 512i Chirp and Knudsen 320BR sub-bottom profilers on the *Melville* have a maximum source level of 198 and 211 dB re 1 μPa · m, respectively. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a bottom profiler emits a pulse is small—even for an SBP more powerful than that on the *Melville* if the animal was in the area, it would have to pass the transducer at close range in order to be subjected to sound levels that could cause TTS.

*Masking*

Marine mammal communications will not be masked appreciably by the sub-bottom profiler signals given their directionality and the brief period when an individual mammal is likely to be within its beam. Furthermore, in the case of most baleen whales, the SBP signals do not overlap with the predominant frequencies in the calls, which would avoid significant masking.

*Behavioral Reactions*

Marine mammal behavioral reactions to other pulsed sound sources are discussed above, and responses to the SBP are likely to be similar to those for other pulsed sources if received at the same levels. However, the pulsed signals from the SBP are considerably weaker than those from the MBES. Therefore, behavioral responses would not be expected unless marine mammals were to approach very close to the source.

*Hearing Impairment and Other Physical Effects*

It is unlikely that the SBP produces pulse levels strong enough to cause hearing impairment or other physical injuries even in an animal that is (briefly) in a position near the source. The SBP is usually operated simultaneously with other higher-power acoustic sources. Many marine mammals will move away in response to the approaching higher-power sources or the vessel itself before the mammals would be close enough for there to be any possibility of effects from the less intense sounds from the SBP. In the case of mammals that do not avoid the approaching vessel and its various sound sources, mitigation measures that would be applied to minimize effects of other sources would further reduce or eliminate any minor effects of the SBP.

**Estimated Take by Incidental Harassment**

All anticipated takes would be ''takes by harassment'', involving temporary changes in behavior. The proposed mitigation measures are expected to minimize the possibility of injurious takes. (However, as noted earlier, there is no specific information demonstrating that injurious ''takes'' would occur even in the absence of the planned mitigation measures.) The sections below describe methods to estimate ''take by harassment'', and present estimates of the numbers of marine mammals that might be affected during the proposed SBC seismic program. The estimates of ''take by harassment'' are based on consideration of the number of marine mammals that might be disturbed appreciably by approximately 600 km of trackline, including turns, using the airgun and approximately 500 km of trackline using the sparker or boomer. The main sources of distributional and numerical data used in deriving the estimates are described below.

The anticipated radii of influence of the MBES and the SBP are less than those for the airgun array. It is assumed that, during simultaneous operations of the airgun array and echosounders, marine mammals close enough to be affected by the echosounders would already be affected by the airguns. However, whether or not the airguns are operating simultaneously with the echosounders, marine mammals are expected to exhibit no more than short-term and inconsequential responses to the echosounders given their characteristics (e.g., narrow downward-directed beam) and other considerations described above. NMFS believes that such reactions are not considered to constitute ''taking.'' Therefore, no additional allowance is included for animals that might be affected by sound sources other than airguns, boomer, and sparker.

Extensive systematic aircraft- and ship-based surveys have been conducted for marine mammals off the U.S. west coast; the most comprehensive and recent density data available for cetacean species in shelf, slope, and offshore waters of California are from the 1991, 1993, 1996, 2001, and 2005 NMFS/SWFSC shipboard surveys as synthesized by Barlow and Forney (2007). The surveys were conducted up to approximately 550 km offshore from June or July to November or December. Densities are available for all of California in each of the five years, and for southern California (south of the latitude of Point Conception) for all years combined (Barlow and Forney, 2007), but not for southern California in each year except 2005 (Forney, 2007). Another set of surveys that included southern California was conducted by NMFS in the ETP during summer and fall 1986–1996, as summarized by Ferguson and Barlow (2001). Densities were calculated for 5° x 5° blocks; the partial block that includes the waters off southern California (Block 58) has its northern boundary at 35°N, just north of Point Conception. It extends off the coast as a wedge with a maximum distance of ~375 km offshore, and included 2925 km of survey effort in Beaufort sea states 0–5 and 600 km of survey effort in Beaufort sea states 0–2. We decided to use those density estimates because a smaller proportion of the waters surveyed were offshore. For two species expected to be common in the SBC but for which there were no sightings in Ferguson and Barlow (2001)—humpback whales and Dall's porpoise—the applicant estimated take using the 2005 densities for southern California in Forney (2007).

Systematic at-sea survey data for pinnipeds are more limited. The only densities to our knowledge are for California sea lions, and are based on ~31,000 km of aerial surveys of the SCB during 1975–1978, as summarized by Bonnell and Ford (1987). There are no density data, to our knowledge, for sea otters in the study area.

Oceanographic conditions, including occasional El Niño and La Niña events, influence the distribution and numbers of marine mammals present in the NEPO, including California, resulting in considerable year-to-year variation in the distribution and abundance of many marine mammal species (Forney and Barlow 1998; Buchanan *et al.* 2001; Escorza-Treviño 2002; Ferrero *et al.* 2002; Philbrick *et al.* 2003; Becker 2007). Thus, for some species the densities derived from recent surveys may not be representative of the densities that will be encountered during the proposed seismic survey.

The estimated numbers of individuals potentially exposed are presented below based on the 160-dB re 1 $\mu Pa_{rms}$ threshold for all cetaceans and pinnipeds. It is assumed that marine mammals exposed to seismic sounds this strong might change their behavior sufficiently to be considered ''taken by harassment''. It should be noted that the following estimates of exposures to various sound levels assume that the surveys will be fully completed; in fact, the planned number of line-kilometers has been increased by 25% to accommodate lines that may need to be repeated, equipment testing, etc. As is typical during ship surveys, inclement weather and equipment malfunctions are likely to cause delays and may limit the number of useful line-kilometers of seismic operations that can be undertaken. Furthermore, any marine mammal sightings within or near the designated exclusion zone will result in the shutdown of seismic operations as a mitigation measure. Thus, the following estimates of the numbers of marine mammals potentially expose to 160 dB re 1 $\mu Pa_{rms}$ sounds are precautionary, and probably overestimate the actual numbers of marine mammals that might be involved. These estimates assume that there will be no weather, equipment, or mitigation delays, which is highly unlikely.

The number of different individuals that could be exposed to GI-gun or boomer sounds with received levels 160 dB re 1 $\mu Pa_{rms}$ on one or more occasions can be estimated by considering the total marine area that would be within the 160-dB radius around the operating seismic sources on at least one occasion along with the expected density of animals in the area. The proposed seismic lines run parallel to each other in close proximity; thus, an individual mammal may be exposed numerous times during the survey. The number of possible exposures to GI-gun and boomer sounds with received levels ≥160 dB re 1 $\mu Pa_{rms}$ (including repeated exposures of the same individuals) can be estimated by considering the total marine area that would be within the 160-dB radius around the operating seismic sources, including areas of overlap. However, it is unlikely that a particular animal would stay in the area during the entire survey. The number of potential exposures and the number of different individuals potentially exposed to ≥160 dB re 1 $\mu Pa_{rms}$ were calculated by multiplying: (1) The expected species density, either ''mean'' (i.e., best estimate) or ''maximum'', times; (2) the anticipated area to be ensonified to that level during seismic operations including overlap (exposures), or; (3) the anticipated area to be ensonified to that level during seismic operations excluding overlap (individuals).

The area expected to be ensonified was determined by entering the planned survey lines into a MapInfo Geographic Information System (GIS), using the GIS to identify the relevant areas by ''drawing'' the applicable 160-dB buffer around each seismic line, and then calculating the total area within the buffers. Areas where overlap occurred (because of closely-spaced lines) were included when estimating the number of exposures, whereas the areas of overlap were included only once when estimating the number of individuals exposed.

Applying the approach described above, approximately 289 $km^2$ would be within the 160-dB isopleth on one or more occasions during the survey, whereas approximately 690 $km^2$ is the area ensonified to ≥160 dB when overlap is included. Thus, it is possible that an average individual marine mammal could be exposed up to two or three times during the survey. Because this approach does not allow for turnover in the mammal populations in the study area during the course of the survey, the actual number of individuals exposed may be underestimated, although the conservative (i.e., probably overestimated) line-kilometer distances used to calculate the area may offset this. Also, the approach assumes that no cetaceans will move away or toward the trackline as the *Melville* approaches in response to increasing sound levels prior to the time the levels reach 160 dB.

The best estimate of the number of individual marine mammals that could be exposed to seismic sounds with received levels ≥160 dB re 1 $\mu Pa_{rms}$ (but below Level A harassment thresholds) during the survey is 508 (Table 4). These estimates were derived from the best density estimates calculated for these species in the area (see Table 4 of SIO's application). However, SIO is requesting takes of marine mammals based on the maximum density estimates (see Table 4 in SIO's application) given that density data is not always precise, hence best and maximum estimates, and that these animals may be in the area. Requested number of marine mammals taken is listed in Table 4 below. In addition, the number of exposures those animals could be subjected to is also outlined. These numbers are based on trackline length, harassment isopleth distances, and density of animals. More information on how number of individuals and number of exposures were calculated can be found in SIO's application. Because the single 45 $in^3$ airgun will likely be operated at a reduced chamber size but exposures are based on maximum chamber size, NMFS believes that the ''best'' estimate of exposures is the most appropriate number to use. The best estimate of the total number of exposures of marine mammals to seismic sounds with received levels ≥160 dB re 1 $\mu Pa_{rms}$ during the survey is 1212, including four blue whale exposures, and one Cuvier's beaked whale exposure. The short-beaked common dolphin is estimated to be exposed most frequently, with a best estimate of 942 exposures.

Two of the six pinniped species listed in Table 4, the Guadalupe fur seal (*Arctocephalus townsendi*) and the Steller sea lion (*Eumetopias jubatus*), are rare in the SBC, and another two, the northern fur seal (*Callorhinus ursinus*) and northern elephant seal (*Mirounga angustirostris*), are not expected to occur there at the time of the proposed survey (November) because they are feeding offshore at that time. Densities are available for the California sea lion, the most abundant pinniped in the Channel Islands, but not for the harbor seal, which could be encountered during the survey. Therefore, allowances have been made in Table 4 for the exposure of a small number (20) of harbor seals to received sound levels ≥160 dB re 1 $\mu Pa_{rms}$.

*Potential Effects on Marine Mammal Habitat*

The proposed seismic surveys will not result in any permanent impact on habitats used by marine mammals, or to the food sources they use. The main impact issue associated with the proposed activity will be temporarily elevated noise levels and the associated direct effects on marine mammals, as described above. The following sections briefly review effects of airguns on fish and invertebrates, and more details are included in Appendices C and D, respectively, of NSF's EA, respectively.

One reason for the adoption of airguns as the standard energy source for marine seismic surveys is that, unlike explosives, they have not been associated with large-scale fish kills. However, existing information on the impacts of seismic surveys on marine fish populations is very limited (see Appendix C of NSF's EA). There are three types of potential effects of exposure to seismic surveys: (1) Pathological, (2) physiological, and (3) behavioral. Pathological effects involve lethal and temporary or permanent sub-lethal injury. Physiological effects involve temporary and permanent primary and secondary stress responses, such as changes in levels of enzymes and proteins. Behavioral effects refer to temporary and (if they occur) permanent changes in exhibited behavior (e.g., startle and avoidance behavior). The three categories are interrelated in complex ways. For example, it is possible that certain physiological and behavioral changes potentially could lead to an ultimate pathological effect on individuals (i.e., mortality).

The specific received sound levels at which permanent adverse effects to fish potentially could occur are little studied and largely unknown. Furthermore, the available information on the impacts of seismic surveys on marine fish is from studies of individuals or portions of a population; there have been no studies at the population scale. Thus, available information provides limited insight on possible real-world effects at the ocean or population scale. This makes drawing conclusions about impacts on fish problematic because ultimately, the most important aspect of potential impacts relates to how exposure to seismic survey sound affects marine fish populations and their viability, including their availability to fisheries.

The following sections provide a general synopsis of available information on the effects of exposure to seismic and other anthropogenic sound as relevant to fish. The information comprises results from scientific studies of varying degrees of rigor plus some anecdotal information. Some of the data sources may have serious shortcomings in methods, analysis, interpretation, and reproducibility that must be considered when interpreting their results (see Hastings and Popper, 2005). Potential adverse effects of the program's sound sources on marine fish are then noted.

*Pathological Effects*—Wardle *et al.* (2001) suggested that in water, acute injury and death of organisms exposed to seismic energy depends primarily on two features of the sound source: (1) The received peak pressure and (2) the time required for the pressure to rise and decay. Generally, as received pressure increases, the period for the pressure to rise and decay decreases, and the chance of acute pathological effects increases. According to Buchanan *et al.* (2004), for the types of seismic airguns and arrays involved with the proposed program, the pathological (mortality) zone for fish and invertebrates would be expected to be within a few meters of the seismic source. Numerous other studies provide examples of no fish mortality upon exposure to seismic sources (Falk and Lawrence, 1973; Holliday *et al.*, 1987; La Bella *et al.*, 1996; Santulli *et al.*, 1999; McCauley *et al.*, 2000a,b, 2003; Bjarti, 2002; Hassel *et al.*, 2003; Popper *et al.*, 2005).

The potential for pathological damage to hearing structures in fish depends on the energy level of the received sound and the physiology and hearing capability of the species in question (see Appendix C of NSF's EA). For a given sound to result in hearing loss, the sound must exceed, by some specific amount, the hearing threshold of the fish for that sound (Popper 2005). The consequences of temporary or permanent hearing loss in individual fish on a fish population is unknown; however, it likely depends on the number of individuals affected and whether critical behaviors involving sound (e.g., predator avoidance, prey capture, orientation and navigation, reproduction, etc.) are adversely affected.

Little is known about the mechanisms and characteristics of damage to fish that may be inflicted by exposure to seismic survey sounds. Few data have been presented in the peer-reviewed scientific literature. As far as we know, there are only two valid papers with proper experimental methods, controls, and careful pathological investigation implicating sounds produced by actual seismic survey airguns with adverse anatomical effects. One such study indicated anatomical damage and the second indicated TTS in fish hearing. The anatomical case is McCauley *et al.* (2003), who found that exposure to airgun sound caused observable anatomical damage to the auditory maculae of ''pink snapper'' (*Pagrus auratus*). This damage in the ears had not been repaired in fish sacrificed and examined almost two months after exposure. On the other hand, Popper *et al.* (2005) documented only TTS (as determined by auditory brainstem response) in two of three fishes from the Mackenzie River Delta. This study found that broad whitefish (*Coreogonus nasus*) that received a sound exposure level of 177 dB re 1 $\mu Pa^2 \cdot s$ showed no hearing loss. During both studies, the repetitive exposure to sound was greater than would have occurred during a typical seismic survey. However, the substantial low-frequency energy produced by the airgun arrays [less than approximately 400 Hz in the study by McCauley *et al.* (2003) and less than approximately 200 Hz in Popper *et al.* (2005)] likely did not propagate to the fish because the water in the study areas was very shallow (approximately 9 m in the former case and <2 m in the latter). Water depth sets a lower limit on the lowest sound frequency that will propagate (the ''cutoff frequency'') at about one-quarter wavelength (Urick, 1983; Rogers and Cox, 1988). Except for these two studies, at least with airgun-generated sound treatments, most contributions rely on rather subjective assays such as fish ''alarm'' or ''startle response'' or changes in catch rates by fishers. These observations are important in that they attempt to use the levels of exposures that are likely to be encountered by most free-ranging fish in actual survey areas. However, the associated sound stimuli are often poorly described, and the biological assays are varied (Hastings and Popper, 2005).

Some studies have reported, some equivocally, that mortality of fish, fish eggs, or larvae can occur close to seismic sources (Kostyuchenko, 1973; Dalen and Knutsen, 1986; Booman *et al.*, 1996; Dalen *et al.*, 1996). Some of the reports claimed seismic effects from treatments quite different from actual seismic survey sounds or even reasonable surrogates. Saetre and Ona (1996) applied a ''worst-case scenario'' mathematical model to investigate the effects of seismic energy on fish eggs and larvae. They concluded that mortality rates caused by exposure to seismic surveys are so low, as compared to natural mortality rates, that the impact of seismic surveying on recruitment to a fish stock must be regarded as insignificant.

*Physiological Effects*—Physiological effects refer to cellular and/or biochemical responses of fish to acoustic stress. Such stress potentially could affect fish populations by increasing mortality or reducing reproductive success. Primary and secondary stress responses of fish after exposure to seismic survey sound appear to be temporary in all studies done to date (Sverdrup *et al.*, 1994; McCauley *et al.*, 2000a, 2000b). The periods necessary for the biochemical changes to return to normal are variable, and depend on numerous aspects of the biology of the species and of the sound stimulus (see Appendix C of NSF's EA).

*Summary of Physical (Pathological and Physiological) Effects*—As indicated in the preceding general discussion, there is a relative lack of knowledge about the potential physical (pathological and physiological) effects of seismic energy on marine fish and invertebrates. Available data suggest that there may be physical impacts on egg, larval, juvenile, and adult stages at very close range. Considering typical source levels associated with commercial seismic arrays, close proximity to the source would result in exposure to very high energy levels. Whereas egg and larval stages are not able to escape such exposures, juveniles and adults most likely would avoid it. In the case of eggs and larvae, it is likely that the numbers adversely affected by such exposure would not be that different from those succumbing to natural mortality. Limited data regarding physiological impacts on fish and invertebrates indicate that these impacts are short term and are most apparent after exposure at close range.

The SIO's proposed seismic survey is predicted to have negligible to low physical effects on the various life stages of fish and invertebrates for its short duration (approximately 25 days each in the Pacific Ocean and Caribbean Sea) and approximately 2,149-km of unique survey lines extent. Therefore, physical effects of the proposed program on fish and invertebrates would not be significant.

*Behavioral Effects*—Behavioral effects include changes in the distribution, migration, mating, and catchability of fish populations. Studies investigating the possible effects of sound (including seismic survey sound) on fish behavior have been conducted on both uncaged and caged individuals (Chapman and Hawkins, 1969; Pearson *et al.*, 1992; Santulli *et al.*, 1999; Wardle *et al.*, 2001; Hassel *et al.*, 2003). Typically, in these studies fish exhibited a sharp ''startle'' response at the onset of a sound followed by habituation and a return to normal behavior after the sound ceased.

There is general concern about potential adverse effects of seismic operations on fisheries, namely a potential reduction in the ''catchability'' of fish involved in fisheries. Although reduced catch rates have been observed in some marine fisheries during seismic testing, in a number of cases the findings are confounded by other sources of disturbance (Dalen and Raknes, 1985; Dalen and Knutsen, 1986; Løkkeborg, 1991; Skalski *et al.*, 1992; Engås *et al.*, 1996). In other airgun experiments, there was no change in catch per unit effort (CPUE) of fish when airgun pulses were emitted, particularly in the immediate vicinity of the seismic survey (Pickett *et al.*, 1994; La Bella *et al.*, 1996). For some species, reductions in catch may have resulted from a change in behavior of the fish, e.g., a change in vertical or horizontal distribution, as reported in Slotte *et al.*, (2004).

In general, any adverse effects on fish behavior or fisheries attributable to seismic testing may depend on the species in question and the nature of the fishery (season, duration, fishing method). They may also depend on the age of the fish, its motivational state, its size, and numerous other factors that are difficult, if not impossible, to quantify at this point, given such limited data on effects of airguns on fish, particularly under realistic at-sea conditions.

For marine invertebrates, behavioral changes could potentially affect such aspects as reproductive success, distribution, susceptibility to predation, and catchability by fisheries. Studies of squid indicated startle responses (McCauley *et al.*, 2000a,b). In other cases, no behavioral impacts were noted (e.g., crustaceans in Christian *et al.*, 2003, 2004; DFO, 2004). There have been anecdotal reports of reduced catch rates of shrimp shortly after exposure to seismic surveys; however, other studies have not observed any significant changes in shrimp catch rate (Andriguetto-Filho *et al.*, 2005). Parry and Gason (2006) reported no changes in rock lobster CPUE during or after seismic surveys off western Victoria, Australia, from 1978–2004. Any adverse effects on crustacean and cephalopod behavior or fisheries attributable to seismic survey sound depend on the species in question and the nature of the fishery (season, duration, fishing method). Additional information regarding the behavioral effects of seismic on invertebrates is contained in Appendix D in NSF's EA.

*Summary of Behavioral Effects*—As is the case with pathological and physiological effects of seismic on fish and invertebrates, available information is relatively scant and often contradictory. There have been well-documented observations of fish and invertebrates exhibiting behaviors that appeared to be responses to exposure to seismic energy (i.e., startle response, change in swimming direction and speed, and change in vertical distribution), but the ultimate importance of those behaviors is unclear. Some studies indicate that such behavioral changes are very temporary, whereas others imply that fish might not resume pre-seismic behaviors or distributions for a number of days. There appears to be a great deal of inter- and intra-specific variability. In the case of finfish, three general types of behavioral responses have been identified: Startle, alarm, and avoidance. The type of behavioral reaction appears to depend on many factors, including the type of behavior being exhibited before exposure, and proximity and energy level of sound source.

During the proposed study, only a small fraction of the available habitat would be ensonified at any given time, and fish species would return to their pre-disturbance behavior once the seismic activity ceased. The proposed seismic program is predicted to have negligible to low behavioral effects on the various life stages of the fish and invertebrates during its relatively short duration and extent.

Because of the reasons noted above and the nature of the proposed activities, the proposed operations are not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations or stocks. Similarly, any effects to food sources are expected to be negligible.

**Proposed Monitoring**

SIO proposes to sponsor marine mammal monitoring during the present project, in order to implement the proposed mitigation measures that require real-time monitoring, and to satisfy the anticipated monitoring requirements of the Incidental Harassment Authorization. Vessel-based marine mammal visual observers (MMVOs) will be based on board the seismic source vessel, and they will watch for marine mammals and turtles near the vessel during seismic operations. MMVOs will also watch for marine mammals and turtles near the seismic vessel for at least 30 minutes prior to the start of seismic operations after an extended shutdown. When feasible, MMVOs will also make observations during daytime periods when the seismic system is not operating for comparison of animal abundance and behavior. Based on MMVO observations, the seismic source will be shut down when marine mammals are observed within or about to enter a designated exclusion zone (EZ). The EZ is a region in which a possibility exists of adverse effects on animal hearing or other physical effects.

MMVOs will be appointed by the academic institution conducting the research cruise, with NMFS Office of Protected Resources concurrence. At least one MMVO will monitor the EZ during seismic operations. MMVOs will normally work in shifts of 4-hour duration or less. The vessel crew will also be instructed to assist in detecting marine mammals and turtles.

Standard equipment for marine mammal observers will be 7 × 50 reticule binoculars and optical range finders. At night, night-vision equipment will be available, although seismic activity will be restricted to daylight hours. The observers will be in wireless communication with ship's officers on the bridge and scientists in the vessel's operations laboratory, so they can advise promptly of the need for avoidance maneuvers or seismic source shut down.

**Proposed Mitigation During Operations**

Mitigation measures that will be adopted will include (1) Vessel speed or course alteration, provided that doing so will not compromise operational safety requirements, (2) GI-gun or boomer shut down within calculated exclusion zones, and (3) shut down at any range in the unlikely event that a North Pacific right whale or a concentration of sea otters is sighted. Two other standard mitigation measures—airgun array power down and airgun array ramp up—are not possible because only one, low-volume GI airgun, boomer, or sparker will be used for the surveys. In addition, avoidance of airgun operations over or near steep slopes or submarine canyons has become a standard mitigation measure, as these are places where beaked whales tend to concentrate. However, no such bathymetric features exist in the study area; therefore, this mitigation measure is not applicable to these surveys.

*Speed or Course Alteration*

If a marine mammal or turtle is detected outside the EZ but is likely to enter it based on relative movement of the vessel and the animal, then if safety and scientific objectives allow, the vessel speed and/or course will be adjusted to minimize the likelihood of the animal entering the EZ. Major course and speed adjustments are often impractical when towing long seismic streamers and large source arrays, but are possible in this case because only one small source and a short (450-m) streamer will be used.

*Shut-Down Requirements and Procedures*

If a marine mammal is detected outside the exclusion zones but is likely to enter the exclusion zone, and if the vessel's speed and/or course cannot be changed to avoid having the animal enter the exclusion zone, the seismic source will be shut down before the animal is within the exclusion zone. Likewise, if a mammal is already within the safety zone when first detected, the seismic source will be shut down immediately.

Following a shut down, seismic activity will not resume until the marine mammal or turtle has cleared the exclusion zone. The animal will be considered to have cleared the exclusion zone if it is visually observed to have left the exclusion zone; has not been seen within the zone for 10 min in the case of small odontocetes and pinnipeds; or has not been seen within the zone for 15 min in the case of mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales.

In the unanticipated event that any cases of marine mammal injury or mortality are judged to result from these activities, SIO will cease operating seismic airgun operation and report the incident to the Office of Protected Resources, NMFS, and the Southwest Regional Administrator, NMFS, immediately.

**Proposed Reporting**

MMVOs will record data to estimate the numbers of marine mammals and turtles exposed to various received sound levels and to document apparent disturbance reactions or lack thereof. Data will be used to estimate numbers of animals potentially ''taken'' by harassment (as defined in the MMPA). They will also provide information needed to order a shutdown of the seismic source when a marine mammal or sea turtles is within or near the EZ.

When a sighting is made, the following information about the sighting will be recorded: Species, group size, and age/size/sex categories (if determinable); behavior when first sighted and after initial sighting; heading (if consistent), bearing, and distance from seismic vessel; sighting cue; apparent reaction to the seismic source or vessel (e.g., none, avoidance, approach, paralleling, etc.); and behavioral pace. In addition, time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare will also be recorded. This data (time, location, etc.) will also be recorded at the start and end of each observation watch, and during a watch whenever there is a change in one or more of the variables.

All observations, as well as information regarding seismic source shutdown, will be recorded in a standardized format. Data accuracy will be verified by the MMVOs at sea, and preliminary reports will be prepared during the field program and summaries forwarded to the operating institution's shore facility and to NSF weekly or more frequently. MMVO observations will provide the following information:

1. The basis for decisions about shutting down the seismic source.
2. Information needed to estimate the number of marine mammals potentially ''taken by harassment''. These data will be reported to NMFS and/or USFWS per terms of MMPA authorizations or regulations.
3. Data on the occurrence, distribution, and activities of marine mammals and turtles in the area where the seismic study is conducted.
4. Data on the behavior and movement patterns of marine mammals and turtles seen at times with and without seismic activity.

A report will be submitted to NMFS within 90 days after the end of the cruise. The report will describe the operations that were conducted and sightings of marine mammals and turtles near the operations. The report will be submitted to NMFS, providing full documentation of methods, results, and interpretation pertaining to all monitoring. The 90-day report will summarize the dates and locations of seismic operations, and all marine mammal and turtle sightings (dates, times, locations, activities, associated seismic survey activities). The report will also include estimates of the amount and nature of potential ''take'' of marine mammals by harassment or in other ways.

All injured or dead marine mammals (regardless of cause) must be reported to NMFS as soon as practicable. Report should include species or description of animal, condition of animal, location, time first found, observed behaviors (if alive) and photo or video, if available.

**Endangered Species Act (ESA)**

Under section 7 of the ESA, NSF has begun consultation with the NMFS, Office of Protected Resources, Endangered Species Division on this proposed seismic survey. NMFS will also consult on the issuance of an IHA under section 101(a)(5)(D) of the MMPA for this activity. Consultation will be concluded prior to a determination on the issuance of the IHA.

**National Environmental Policy Act (NEPA)**

NSF prepared an Environmental Assessment (EA) of a Marine Geophysical Survey by the R/V *Melville* in the Santa Barbara Channel, November 2008. NMFS will either adopt NSF's EA or conduct a separate NEPA analysis, as necessary, prior to making a determination of the issuance of the IHA.

**Preliminary Determinations**

NMFS has preliminarily determined that the impact of conducting the seismic survey in the SBC may result, at worst, in a temporary modification in behavior (Level B Harassment) of small numbers of 26 species of marine mammals. This activity is expected to result in a negligible impact on the affected species or stocks. There are no subsistence uses of affected marine mammals in this area.

For reasons stated previously in this document, this determination is supported by: (1) The likelihood that, given sufficient notice through relatively slow ship speed, marine mammals are expected to move away from a noise source that is annoying prior to its becoming potentially injurious; (2) the fact that marine mammals would have to be closer than 35 m (114 ft) in water less than 1,000 m to be exposed to levels of sound which could result in Level A harassment (injury); (3) the 35 m distance is conservative as it is for the airgun opening at full chamber size (45 $in^3$) and the airgun will likely be operating at reduced chamber size; and (4) the marine mammal detection ability by trained observers is high at that very short distance from the vessel. As a result, no take by injury or death is anticipated, and the potential for temporary or permanent hearing impairment is very low and will be avoided through the incorporation of the proposed mitigation measures.

While the number of marine mammals potentially harassed will depend on the distribution and abundance of marine mammals in the vicinity of the survey activity, the number of potential harassment takings is estimated to be small, less than a few percent of any of the estimated population sizes, and has been mitigated to the lowest level practicable through incorporation of the measures mentioned previously in this document.

**Proposed Authorization**

As a result of these preliminary determinations, NMFS proposes to issue an IHA to SIO for conducting a marine geophysical survey in the Santa Barbara Channel, November 2008, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: August 22, 2008.

**Helen M. Golde,**

*Deputy Director, Office of Protected Resources, National Marine Fisheries Service.*

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## DEPARTMENT OF COMMERCE

### National Oceanic and Atmospheric Administration

**RIN 0648–XI06**

### Marine Mammal Authorization Program Integration of Registration for Selected West Coast Fisheries

**AGENCY:** National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

**ACTION:** Notice; expansion of integrated registration program.

**SUMMARY:** NMFS is providing notice that it is increasing the number of fisheries for which the Marine Mammal Authorization Program (MMAP) registration is integrated with existing state and Federal fishery licensing and permitting programs, beginning with the 2009 List of Fisheries (LOF). NMFS is integrating MMAP registration at this time only for specific Category I or II fisheries regulated under fishery management plans (FMPs) administered by the Southwest Regional Office, or fisheries under permits issued by the state of California. Fishermen who participate in a Category I or II fishery for which registration is not integrated with existing state or Federal permitting programs must continue to register directly with NMFS through the MMAP.

**ADDRESSES:** For West Coast fisheries, registration information and marine mammal injury/mortality reporting forms may be obtained from the following regional office: NMFS, Southwest Region, Sustainable Fisheries Division, Attn: Lyle Enriquez, 501 West Ocean Blvd., Suite 4200, Long Beach, CA 90802.

**FOR FURTHER INFORMATION CONTACT:** Patricia Lawson, Office of Protected Resources, 301–713–2322; or Lyle Enriquez, Southwest Regional Office, 562–980–4025.

**SUPPLEMENTARY INFORMATION:** According to the Marine Mammal Protection Act (MMPA), all fishermen who participate in a Category I or II fishery listed in the annual LOF must be registered with a MMAP (section 118(c)(2)(A)). A fishery is classified on the LOF based on whether it has frequent (Category I), occasional (Category II), or remote (Category III) likelihood of incidental mortality and serious injury (or bycatch) of marine mammals. The MMAP provides an authorization for commercial fishermen which allows the incidental (i.e., non-intentional) taking of marine mammals pursuant to the MMPA during the course of commercial fishing operations. Participants in Category III fisheries are not required to register with the MMAP. Fishermen participating in any commercial fishery, regardless of category, are required to report all incidental injuries and mortalities of marine mammals to NMFS within 48 hours of returning from a fishing trip. For a complete description of requirements for fishermen participating in Category I, II, and III fisheries, please consult 50 CFR part 229, subpart A.

Rather than requiring all participants in Category I and II fisheries to register individually, the MMPA directs NMFS to integrate registration with existing state or Federal fishery permitting or licensing programs (section 118(c)(5)(A)). NMFS' goals for the integrated registration program include ensuring consistency in registration procedures across a greater number of fisheries, increasing the number of registrants to better reflect the level of participation in the fisheries, and conducting outreach to the fishing industry with regard to MMPA requirements. Using data from existing fishery licensing programs, the MMAP integration will reduce the registration burden on the fishing industry while facilitating the protection and conservation of marine mammals through increased outreach efforts. In a licensing system that is integrated with the MMAP, fishermen are not required to submit an MMAP registration/renewal form or the $25 processing fee to NMFS in order to receive or renew their MMAP Authorization Certificates.

NMFS will integrate the following fisheries that are managed under the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801 *et seq.*: the Coastal Pelagics FMP (California anchovy, mackerel, and sardine purse seine fishery) fisheries, and the Highly Migratory Species FMP (California pelagic longline, California tuna purse seine, and California/Oregon drift gillnet fisheries) fisheries. In order to integrate state-managed fisheries, NMFS is obtaining fishery license-holder information from the State of California. Category I and II state managed fisheries that NMFS will integrate include the California angel shark/halibut and other species set gillnet; and California squid purse seine fisheries. NMFS will make an annual