Request to National Oceanic and Atmospheric Administration (NOAA) for Incidental Take regulations governing Seismic Surveys on the Outer Continental Shelf (OCS) of the Gulf of Mexico (GOM) (A response to Subpart I — MMPA Request Requirements at 50 CFR §216.104)

Revision to original request package submitted December 20, 2002. Revisions cover new information that has become available since submission of the 2002 original and 2004 request packages.

18 April 2011

(1) A Detailed Description of the Specific Activity or Class of Activities That Can Be Expected To Result in Incidental Taking of Marine Mammals;

Geophysical surveys are performed to obtain information on surface and near-surface geology (high - resolution surveys) and on subsurface structures and formations (seismic surveys and vertical seismic profile (VSP) surveys). Geophysical surveys take place before and after a lease sale. High-resolution surveys done in support of lease operations are authorized under the terms of a lease agreement and are referred to as post-lease surveys. Seismic surveys are performed before and after lease sales, are primarily performed off-lease or on lands leased to a third party, and are authorized under the Bureau of Ocean Energy Management, Regulation, and Enforcement's (BOEMRE) permitting program as mandated under the OCS Lands Act.

BOEMRE defines two primary categories of seismic surveys: (1) deep seismic (OBS, VSP, 2D, 3D, and Wide azimuth surveys (WAZ)), and (2) high resolution surveys. In general, seismic surveys are deep penetrating and are used to obtain data about geologic formations greater than 300 m below the seafloor. Typical seismic surveying operations tow a seismic sound source, 8 to 12 meters below the sea surface. The seismic sound source is generally an air gun array but may also be a boomer, sparker or other technology, and one or more streamers (cable(s) with hydrophone signal receivers) are also towed behind the vessel. An alternative to streamers is the deployment of seafloor geophones either connected to ocean bottom cables (OBC) or nodes placed individually on the seafloor (OBS). The airgun array produces underwater sound waves by releasing compressed air into the water column, creating an acoustical energy pulse. The intermittent release of compressed air creates a regular series of strong acoustic impulses separated by silent periods lasting up to 16 seconds, depending on survey type and depth to the target formations. The acoustic signals are reflected off subsurface structures and sediments and recorded back near the surface via the hydrophones in the streamer(s) or nodes/geophones. Streamers are often 3 to 12 km in length and the speed at which the vessels tow them varies depending on the type of survey, but is typically between 3 to 4.5 kt (about 5 to 8km/h) with gear deployed.

High-resolution surveys collect data on surface and near-surface geology used to identify archeological sites, potential shallow geologic and manmade hazards for engineering, and site planning for bottom-founded structures. Seismic surveys include two-dimensional (2-D), three-dimensional (3-D) surveys, and Wide Azimuth Surveys (WAZ). Data from these surveys are used to map the structural characteristics of stratigraphically important horizons in order to identify potential hydrocarbon traps. These high resolution surveys mainly use a single air gun but other sound sources, such as boomers, sparkers, chirpers, may also be used. These sound sources are powered typically by mechanically or electromagnetically. (Further detail is provided in the sections below and in our Final PEA (Minerals Management Service (MMS), 2004.)

Deep Seismic

For 2-D seismic surveys, a single streamer is towed behind the survey vessel, together with a single source or airgun array. Seismic vessels generally follow a systematic pattern during a survey, typically a simple grid pattern for 2-D work with lines no closer than half a kilometer. In simplistic terms, 3-D

surveys collect a very large number of 2-D slices, with minimum line separations of only 25 to 30 m. A 3-D survey may take many months to complete (e.g. 3-18) and involves a precise definition of the survey area and transects, including multiple passes to cover a given survey area. For seismic surveys, 3-D methods represent a substantial improvement in resolution and useful information relative to 2-D methods. Most areas in the Gulf of Mexico previously surveyed using 2-D have been, or will be, surveyed using 3-D.

The 3-D seismic surveying provides the opportunity to create higher resolution subsurface images and to resolve imaging challenges, thereby enabling a more accurate assessment of potential hydrocarbon reservoirs. As a result the oil and gas industry is able to optimally locate exploration and development wells, thereby maximizing the success rate of exploration wells and minimizing the number of wells required to develop a field. State-of-the-art interactive computer mapping systems can handle much denser data coverage than the older 2-D seismic surveys. Multiple-source and multiple-streamer technologies are used for 3-D seismic surveys. A typical 3-D survey might employ a dual array of 18 guns per array. At 10 m from the source, the pressure experienced is approximately ambient pressure plus 1 atmosphere (atm). The streamer array might consist of 6 to 8 parallel cables, each 3,000 to 12,000 m long, spaced 25 to 100 m apart. An 8-streamer array used for deepwater surveys is typically 700 m wide. A series of 3-D surveys collected over time (commonly referred to as four-dimensional or 4-D seismic surveying) is used for reservoir monitoring and management (the movement of oil, gas, and water in reservoirs can be observed over time). Increasingly, the data collected in a 3-D seismic survey can be processed to provide near surface images adequate for many of the needs previously met by high-resolution surveys.

Wide-azimuth towed-streamer (WAZ) acquisition has emerged in the last few years as a step change in marine acquisition technology in the Gulf of Mexico. This came about because the risky exploration and development of deepwater subsalt reservoirs required seismic data to have better illumination, higher signal-to-noise ratio, and improved resolution. Wide azimuth acquisition configurations involve multiple vessels operating concurrently in a variety of source vessel-to-acquisition vessel geometries. Several source vessels (usually 2-4) are used in coordination with single or dual receiver vessels either in a parallel or rectangular arrangement with a typical 1200-m vessel spacing to maximize the azimuthal quality of data acquired. It is not uncommon to have sources also deployed from the receiver vessels in addition to source-only vessels. This improves the signal-to-noise ratio and helps to better define the salt and sub-salt structures in the deep waters of the GOM. Coiled (spiral) surveys are a further refinement of the wide azimuth acquisition of subsalt data. These surveys can consist of a single source/ receiver arrangement or a multi vessel operation with multi sources where the vessels navigate in a coiled or spiral pattern over the area of acquisition.

Deep seismic surveying is deeper penetration, high energy and low frequency (2-D, 3-D, 4-D or WAZ) and may also be done on leased blocks for more accurate identification of potential reservoirs, thereby aiding in the identification of additional reservoirs in "known" fields. This 3-D technology can be used in developed areas to identify bypassed hydrocarbon-bearing zones in currently producing formations and new productive horizons near or below currently producing formations. It can also be used in developed areas for reservoir monitoring and field management. Four-dimensional (4D) seismic surveying is predominantly used for on-lease reservoir monitoring and management. Through time-lapsed surveys, the movement of oil, gas, and water in reservoirs can be observed over time, and that critical information used to adjust production techniques and decisions, leading to more efficient production of the reservoir and the ultimate recovery of a greater portion of the original oil and gas in place. Surveying may occur periodically throughout the productive life of a lease, as frequently as every six months.

Ocean Bottom Surveys (OBS)

Ocean bottom cable (OBC) surveys were originally designed to enable seismic surveys in congested areas, such as producing fields, with their many platforms and producing facilities. Autonomous nodes, deployed and retrieved by either cable or remotely operated vehicles (ROVs), are now used as an alternative to cables. OBC cable surveys have been found to be useful for obtaining multi-component (i.e., seismic pressure, vertical, and the two horizontal motions of the water bottom, or seafloor) information.

OBC surveys and nodal acquisition require the use of multiple ships (i.e., usually two ships for cable or node layout/pickup, one ship for recording, one ship for shooting, and two utility boats). These ships are generally smaller than those used in streamer operations, and the utility boats can be very small. Operations are conducted "around the clock" and begin by dropping the cables off the back of the layout boat or by deployment of the nodal receivers by ROVs. Cable length or the numbers of nodes depend upon the survey demands; it is typically 4.2 km but can be up to 12 km. However depending on spacing and surveys size, hundreds of nodes can be deployed and re-deployed over the span of the survey. Groups of seismic detectors, usually hydrophones and vertical motion geophones, are attached to the cable in intervals of 25 to 50 m or autonomous nodes are spaced similarly. Multiple cables/ nodes are laid parallel to each other using this layout method with a 50 m-interval between cables/ nodes. Typically dual airgun arrays are used on a single source vessel. When the cable/ node is in place, a ship towing an airgun array (which is the same airgun array used for streamer work) passes between the cables/ nodes, firing every 25 m. Sometimes a faster source ship speed of 6 knots, instead of the normal 4.5 knots speed, is used with a decrease in time between gun firings. After a source line is shot, the source ship takes about 10 to 15 minutes to turn around and pass down between the next two cables or line of nodes. When a cable/node is no longer needed to record seismic data, it is picked up by the cable pickup ship and is moved over to the next position where it is needed. The nodes are retrieved by an ROV. A particular cable/node can lay on the bottom anywhere from 2 hours to several days, depending upon operation conditions. Normally a cable will be left in place about 24 hours. However, nodes may remain in place until the survey is completed or recovered and then re-deployed by an ROV.

Location of the cables/nodes on the bottom is done by acoustic pingers located at the detector groups and by using the time of first arrival of the seismic pulse at the detector group. The acoustic pinger uses frequencies in the 9-13 kHz range. A detector group is a node or group of nodes that enable the seismic ship to accurately determine node location. To obtain more accurate first arrival times, the seismic data are recorded with less electronic filtering than is normally used. This detailed location is combined with normal GPS navigational data collected on the source ship. In deep-water, the process of accurately locating bottom cables/ nodes is more difficult because of the effects of irregular water bottoms and of the thermal layers, which affect travel times and travel paths, thus causing positioning errors.

High Resolution Surveys

High-resolution site surveys are conducted to investigate the shallow subsurface for geohazards and soil conditions, as well as to identify potential benthic biological communities (or habitats) and archaeological resources in support of review and mitigation measures for OCS exploration and development plans. Information also can be recovered at much greater depths, so that some surveys are used for exploration purposes. A typical operation consists of a ship towing an airgun (about 25 m behind the ship) and a 600-m streamer cable with a tail buoy (about 700 m behind the ship). The ship travels at 3 to 3.5 kn (5.6 to 6.5 km/h), and the airgun is fired every 7 to 8 s (or about every 12.5 m). Typical surveys cover one lease block, which is 4.8 km on a side. BOEMRE regulations require information be gathered on a 300- by 900-m grid, which amounts to about 129 line km of data per lease block. If the BOEMRE has identified a block as having a high probability for the presence of historic archaeological resources (i.e., shipwrecks), grid points must be on a 50 m spacing (i.e., pursuant to NTL No. 2005-G07). Including line turns, the time to survey one block is about 36 h; however, streamer and airgun deployment and other operations add to the total survey time.

High-resolution surveying is done on a site-specific or lease-specific basis or along a proposed pipeline route. These surveys are used to identify potential shallow, geologic hazards for engineering and site planning for bottom-founded structures. They are also used to identify environmental resources such as hard-bottom areas, topographic features, or historical archaeological resources. Post-lease, high-resolution seismic surveying is usually done at least once for each lease, except for leases where previous surveys preclude the requirement for new surveys.

High resolution 3-D surveys using ships towing multiple streamer cables have become available, however their use in the GOM is uncommon . Since multiple streamers are towed, the ships tend to be slightly larger (47 m vs. 37 m). Up to six streamers 100 to 200 m long are used with a tri-cluster of airguns.

(2) The Date(s) and Duration of Such Activity and the Specific Geographical Region Where It Will Occur;

Oil and gas exploration on parts of the continental shelf of the northern GOM (U.S. waters north of the Exclusive Economic Zone (EEZ) boundary) is in a mature state, although large discoveries are expected in deeper waters. The Eastern GOM remains largely under explored. New seismic survey activity is expected to occur in the Eastern Planning Area, however industry activity in the Eastern Planning Area has historically been limited to the westernmost portions of the planning area due to lack of availability of acreage for lease and is usually defined by the 5-Year Leasing Program (see http://www.boemre.gov/5-year/). Figure 2-1 defines BOEMRE planning areas and administrative boundaries.

The different types of geophysical survey activity in the northern Gulf can occur on any day of a given year during the time period of the requested rule (5 years). Specific geophysical surveys may span one day, weeks, or months. Geophysical surveys may be conducted in any Federal or state waters of the Gulf of Mexico. Figure 2-2 illustrates the 9 acoustic regions discussed below. Tables 2-1 through 2-5 provide the number of surveys, by blocks surveyed (~ 3 miles x 3 miles), for nine regions (Central, Western and Eastern – Shelf, Slope, Deep), by projected estimation of the anticipated level of effort (e.g., for 2010 – 2014), for each of the survey types. For OBS surveys in Table 2-1, "Light" is assumed to be approximately 50 blocks surveyed. For each of the tables, "shelf" is defined as 0-200 m, "slope" is 200 – 1000 m, and "deep" is considered >1000 m.

Figure 2-1. BOEMRE's Gulf of Mexico Planning Areas and Administrative Boundaries

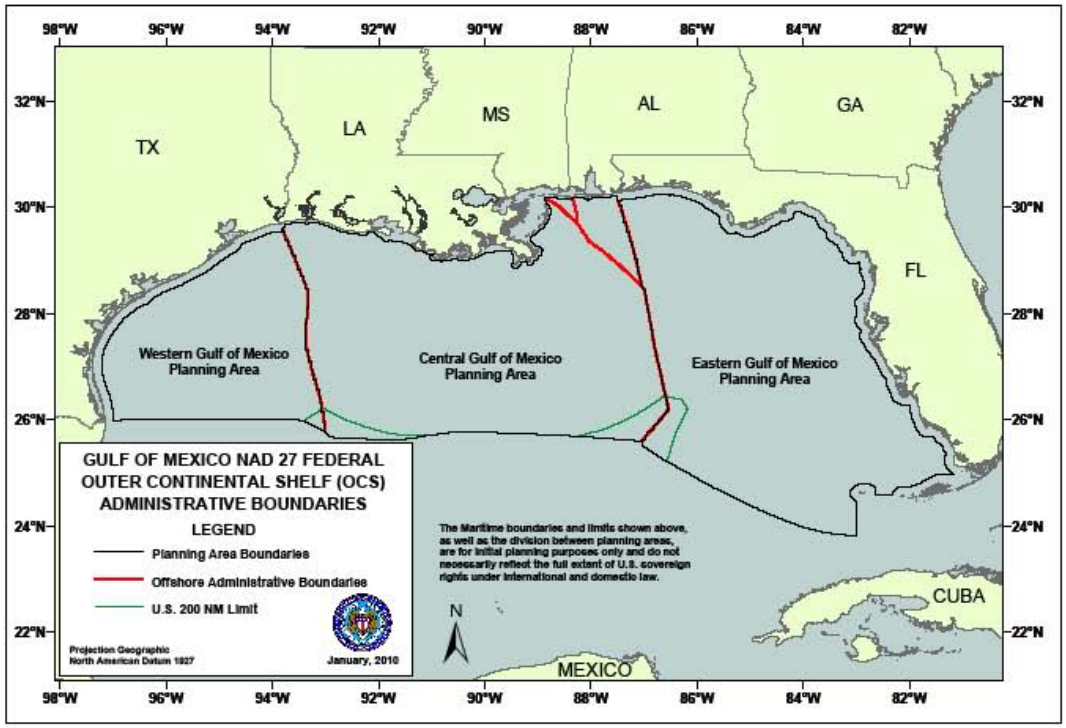

Figure 2-2. Acoustic Regions and Representative Model Sites in the Gulf of Mexico.

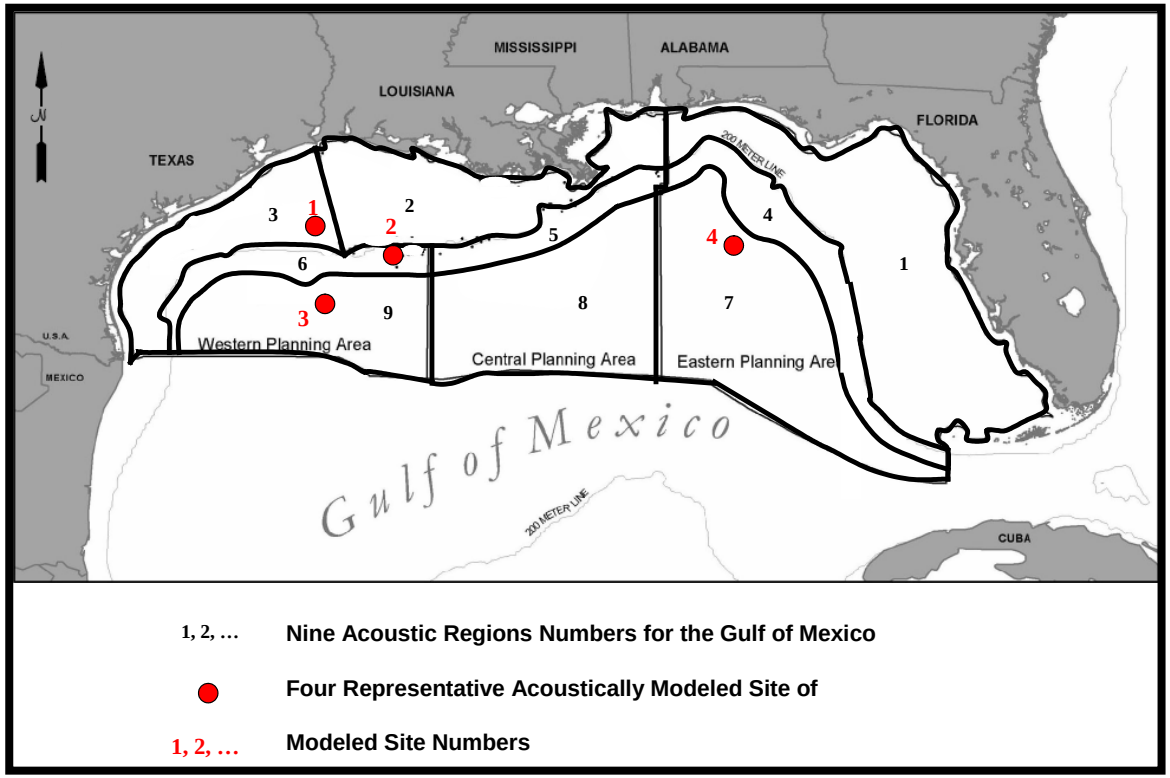

Table 2-1. OBS Surveys in each BOEMRE Region, by Year, Number of Blocks and Approximate Depth Zone

"E" indicates Eastern Planning Area; "C" indicates Central Planning Area; and "W" indicates Western Planning Area

Depth Zone: / BOEMRE Planning Region:	Shelf E	Shelf C	Shelf W	Slope E	Slope C	Slope W	Deep E	Deep C	Deep W
Year:									
2012	0	50	50	0	50	0	0	50	0
2013	0	50	50	0	50	0	0	50	0
2014	0	50	50	0	50	0	0	50	0
2015	0	50	50	0	50	0	0	50	0
2016	0	50	50	0	50	0	0	50	0
2017	0	50	50	0	50	0	0	50	0

Table 2-2. Number of Lease Blocks Surveyed by Year, and Approximate Depth Zone, by 2-D Seismic in each BOEMRE Region.

Depth Zone: / BOEMRE Planning Region:	Shelf E	Shelf C	Shelf W	Slope E	Slope C	Slope W	Deep E	Deep C	Deep W
Year:									
2012	10434.5	92.2	246.7	10434.5	92.2	246.7	15651.8	925.6	246.7
2013	2296.5	640.4	1666.8	3444.7	640.4	1666.8	5741.2	5756.8	3333.6
2014	74.1	134.8	277.8	111.1	134.8	277.8	185.2	1211.9	555.6
2015	1259.4	134.8	277.8	1889.0	134.8	277.8	3148.4	1211.9	555.6
2016	14964.2	134.8	277.8	22446.2	134.8	277.8	37410.4	1211.9	555.6
2017	12186.2	134.8	277.8	18279.2	134.8	277.8	30465.4	1211.9	555.6

Table 2-3. Number of Lease Blocks Surveyed by Year, and Approximate Depth Zone, by 3-D Seismic in each BOEMRE Region.

Depth Zone: BOEMRE Planning Region:	Shelf E	Shelf C	Shelf W	Slope E	Slope C	Slope W	Deep E	Deep C	Deep W
Year:									
2012	137.	648.	219.	137.3	108.4	0	205.	1080	657.
2013	241.	357.	48.2	362.1	60.0	0	603.	715.	192.
2014	140.	279.	6.0	210.9	46.1	0	351.	746.	24.0
2015	40.6	525.	43.0	60.9	86.5	0	101.	1400	172.
2016	130.	368.	6.0	195.9	60.7	0	326.	982.	24.0
2017	74.6	347.	46.0	111.9	57.3	0	186.	927.	184.

Table 2-4. Number of Lease Blocks Surveyed by Year, and Approximate Depth Zone, by WAZ Surveys in each BOEMRE Region.

Depth Zone: BOEMRE Planning Region:	Shelf E	Shelf C	Shelf W	Slope E	Slope C	Slope W	Deep E	Deep C	Deep W
Year:									
2012	0	367.	81.8	0	734.1	163.4	0	1192	816.
2013	0	272.	66.9	25.0	816.1	133.6	0	1196	534.
2014	0	232.	89.2	12.5	814.2	178.2	12.5	1163	712.
2015	0	268.	79.3	12.5	939.5	158.4	12.5	1342	633.
2016	0	200.	51.6	276.0	702.9	103.1	276.	1004	412.
2017	0	264.	92.8	213.5	924.7	185.5	213.	1321	741.

Table 2-5. Number of Lease Blocks Surveyed by Year, and Approximate Depth Zone, by 2-D High Resolution Surveys in each BOEMRE Region.

Depth Zone: BOEMRE Planning Region:	Shelf E	Shelf C	Shelf W	Slope E	Slope C	Slope W	Deep E	Deep C	Deep W
Year:									
2012	0.54	33.26	2.66	0.54	33.26	2.66	0.54	33.26	2.66
2013	0.58	36.32	2.91	0.58	36.32	2.91	0.58	36.32	2.91
2014	0.64	39.38	3.15	0.64	39.38	3.15	0.64	39.38	3.15
2015	0.64	39.38	3.15	0.64	39.38	3.15	0.64	39.38	3.15
2016	0.61	37.85	3.03	0.61	37.85	3.03	0.61	37.85	3.03
2017	0.61	37.85	3.03	0.61	37.85	3.03	0.61	37.85	3.03

(3) The Species and Numbers of Marine Mammals Likely To Be Found within the Activity Area;

See table below.

Table 3.1. Population Estimates for Marine Mammal Species in the Northern Gulf of Mexico

Species	**Best Population Estimate**[1] (Minimum estimates)	**ESA Status**	**MMPA Status**
Killer Whale (*Orcinus orca*)	49 (28)	Non-listed	Not classified
False Killer Whale (*Pseudorca crassidens*)	777 (501)	Non-listed	Not classified
Pygmy Killer Whale (*Feresa attentuata*)	323 (203)	Non-listed	Not classified
Dwarf Sperm Whale (*Kogia sima*)	453[a] (340)	Non-listed	Not classified
Pygmy Sperm Whale (*Kogia breviceps*)	453[a] (340)	Non-listed	Not classified
Melon-headed Whale (*Peponocephala electra*)	2,283 (1,293)	Non-listed	Not classified
Risso's Dolphin (*Grampus griseus*)	1,589 (1,271)	Non-listed	Not classified
Short-finned Pilot Whale (*Globicephala macrorhynchus*)	716 (542)	Non-listed	Not classified
Sperm Whale (*Physeter macrocephalus*)	1,665 (1,409)	Endangered	Depleted
Bryde's Whale (*Balaenoptera edeni*)	15 (5)	Non-listed	Not classified
Cuvier's Beaked Whale (*Ziphius cavirostris*)	65 (39)	Non-listed	Not classified
Blainville's Beaked Whale (*Mesoplodon densirostris*)	57[b] (24)	Non-listed	Not classified
Gervais' Beaked Whale (*Mesoplodon europaeus*)	57[b] (24)	Non-listed	Not classified
Bottlenose Dolphin (*Turisops truncatus*)	42,841[c] (UNK)	Non-listed	Not classified
Atlantic Spotted Dolphin (*Stenella frontalis*)	27,393[d] (UNK)	Non-listed	Not classified
Pantropical Spotted Dolphin (*Stenella attenuatus*)	34,067 (29.311)	Non-listed	Not classified
Striped Dolphin (*Stenella coeruleoalba*)	3,325 (2,266)	Non-listed	Not classified
Spinner Dolphin (*Stenella longirostris*)	1,989 (1,356)	Non-listed	Not classified
Rough-toothed Dolphin (*Steno bredanensis*)	2,942 [d] (UNK)	Non-listed	Not classified
Clymene Dolphin (*Stenella clymene*)	6,575 (4,901)	Non-listed	Not classified

Species	Best Population Estimate[1] (Minimum estimates)	ESA Status	MMPA Status
Fraser's Dolphin (*Lagenodelphis hosei*)	726[e] (UNK)	Non-listed	Not classified
Absent from GOM Stock Assessment:			
Northern Right Whale (*Eubalaena glacialis*)	Extralimital[f]	Endangered	Depleted
Minke Whale (*Balaenoptera acutorostrata*)	Rare[g]	Non-listed	Not classified
Sei Whale (*Balaenoptera edeni*)	Rare	Endangered	Depleted
Blue Whale (*Balaenoptera musculus*)	Extralimital	Endangered	Depleted
Fin Whale (*Balaenoptera physalus*)	Rare	Endangered	Depleted
Humpback Whale (*Megaptera novaeangliae*)	Rare	Endangered	Depleted
Sowerby's Beaked Whale (*Mesoplodon bidens*)	Extralimital	Non-listed	Not classified

[1] Source: U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2009 (Waring et al. 2009).
[a] This estimate may include both the dwarf and pygmy sperm whales.
[b] This estimate includes Gervais' beaked whales and Blainville's beaked whales.
[c] This estimate is from the Gulf of Mexico Marine Mammal Stock Assessments – 2007 (Waring et al. 2007). This estimate combines abundance estimates from the Northern Gulf of Mexico Oceanic Stock (3,708), Continental Shelf Stock (21,531), and Coastal Stock (17,602). The coastal stock population size has not been estimated for more than 8 years and these data are from 1992-1994..
[d] This estimate is from the Gulf of Mexico Marine Mammal Stock Assessments – 2007 (Waring et al , 2007).
[e] This estimate is from the Gulf of Mexico Marine Mammal Stock Assessments – 2005 (Waring et al , 2005).
[f] Extralimital: known on the basis of only a few records that probably resulted from unusual wanderings of animals into the region (Würsig et al. 2000).
[g] Rare: present in such small numbers throughout the region that it is seldom seen (Würsig et al. 2000).

(4) A Description of the Status, Distribution, and Seasonal Distribution (When Applicable) of the Affected Species or Stocks of Marine Mammals Likely To Be Affected by Such Activities;

The Gulf of Mexico is a semi-enclosed marginal sea of the Atlantic Ocean bounded by the United States, Mexico, and Cuba. Entry from the Atlantic Ocean into the Gulf of Mexico is gained through the Straits of Florida, and entry from the Caribbean Sea is gained through the Yucatan Channel. The Gulf is characterized by a very wide, gently sloping continental shelf around most of its margin. The only area of the U.S. Gulf (north of the Exclusive Economic Zone) where the water depth reaches 200 m within 50 km of the shore is off the Mississippi River delta. Continental shelf waters (< 200 m deep) comprise about 35 percent of the Gulf surface and continental slope waters (200-3,000 m) make up another 40 percent (Wursig et al. 2000). In contrast to the smooth, gentle slope of the continental shelf, the Gulf continental slope is steep and irregular with canyons and knolls. The remaining 25 percent of the Gulf waters are the abyssal depths, mainly of the Sigsbee Abyssal Plain.

The U.S. Gulf of Mexico marine mammal community is diverse and distributed throughout the northern Gulf waters. The only two species that are commonly found in continental shelf waters are bottlenose dolphins and Atlantic spotted dolphins (Fulling et al. 2003). Slope waters are routinely inhabited by 20 species, most of which have worldwide distribution in deep, warm-temperate to tropical waters. Two exceptions to worldwide distributions are Atlantic spotted dolphins (*Stenella frontalis*) and clymene dolphins (*Stenella clymene*). Common in the Gulf, these two species are found only in the Atlantic and its associated waters.

Listed below are the individual species that routinely inhabit the U.S. Gulf of Mexico and, thus, might be affected by the subject activities. Mullin and Fulling (2004) reported that many of these species were widely distributed but some had a more regional distribution and these are noted in species accounts. It was also reported that there was some evidence of seasonal changes in slope waters species abundance

but that the Gulf marine mammal community remained diverse and abundant throughout the year and no commonly occurring species vacated the slope waters seasonally (Mullin et al. 2004). Seasonal observations are also reported under individual species accounts. Unless otherwise cited, the information in the individual species accounts is from the 2009 Stock Assessment Report available on the NOAA Office of Protected Resources' website. Additional information on marine mammal species, abundance, and distribution can be found in MMS (2004).

There are species that have been reported from Gulf waters, either by sighting or stranding, that are not included in the species accounts (Wursig et al. 2000; Mullin and Fulling 2004). These species include the blue whale (*Balaenoptera musculus*), the northern right whale (*Eubalaena glacialis*), and the Sowerby's beaked whale (*Mesoplodon bidens*), all considered extralimital in the Gulf of Mexico, and the humpback whale (*Megaptera novaeangliae*), the fin whale (*Balaenoptera physalus*), the sei whale (*Balaenoptera borealis*), and the minke whale (*Balaenoptera acutorostrata*), all considered rare occasional migrants in the Gulf. Because of the rarity of these species in the Gulf, no potential effect from subject activities is expected.

For all the species listed below, information about the optimum sustainable population (OSP) and the potential biological removal (PBR) are included. OSP is defined in 16 U.S.C. §1362(9) as "the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element." PBR is defined in 16 U.S.C. §1362(20) as "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population."

Killer Whale (*Orcinus orca*)

Status

The population of killer whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

This species is not listed as endangered or threatened under the Endangered Species Act. The status of killer whales in the northern Gulf of Mexico, relative to the optimum sustainable population (OSP), is unknown. There are not sufficient data to assess population trends for this species. This stock is not a strategic stock because it is assumed that the e average annual human-related serious injury and mortality does not exceeded potential biological removal (PBR).

Distribution

The killer whale is a cosmopolitan species that occurs in all oceans and seas and is considered the most widespread cetacean worldwide. These animals are not limited by such habitat features as water depth or temperature (Reeves et al. 2002). Killer whale sightings in the northern GOM have primarily been in deeper waters off the continental shelf (>200 m).

Seasonal Distribution

Killer whale sightings in the northern Gulf of Mexico have occurred primarily in summer months (May through September). Thirty-two individual killer whales have been photo-identified in the GOM with 6 resighted over a 5-year period and 1 resighted over 10 years. Three of the resightings involved individual whales that had moved over 1,100 km from the original sighting location (O'Sullivan and Mullin, 1997). It is not known whether killer whales in the northern GOM remain within the GOM or range more widely (Würsig et al. 2000). However, resighting individual whales in similar seasons in subsequent years would suggest that either the animals return seasonally to the northern Gulf after moving out of the area (particularly if surveys at other times of the year did not find killer whales) or that killer whales remain in the northern Gulf year.

False Killer Whale (*Pseudorca crassidens*)

Status

The population of false killer whales in the Gulf of Mexico is provisionally being considered one stock for management purposes by NMFS. Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

This species is not listed as endangered or threatened under the Endangered Species Act. The status of false killer whales in the northern Gulf of Mexico, relative to the OSP, is unknown. There are not sufficient data to assess population trends for this species. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The false killer whale occurs in oceanic depths (usually >1,000 m) of all tropical and warm temperate waters (Reeves et al. 2002). Species sightings in the northern GOM occurred primarily in the deep waters off the continental shelf.

Seasonal Distribution

False killer whales have only been sighted during the late spring and summer by extensive NMFS aerial and shipboard surveys. Whether this indicates seasonal distribution or is an artifact of survey effort is not clear.

Pygmy Killer Whale (*Feresa attentuata*)

Status

The population of pygmy killer whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

Pygmy killer whales are not listed as threatened or endangered under the Endangered Species Act. The status of pygmy killer whales in the northern Gulf of Mexico, relative to the OSP, is unknown. There are not sufficient data to assess population trends for this species. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The pygmy killer whale is an oceanic species with a worldwide, pantropical range (Reeves et al. 2002). Species sightings in the northern GOM occurred primarily in the deeper oceanic waters off the continental shelf.

Seasonal Distribution

Sightings of pygmy killer whales have occurred in all seasons in the northern GOM during NMFS surveys.

Dwarf Sperm Whale (*Kogia sima*)

Status

The population of dwarf sperm whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to

differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of dwarf sperm whales in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR

Distribution

The dwarf sperm whale is distributed worldwide in temperate to tropical waters. Reeves et al. (2002) reported that pygmy sperm whales are thought to inhabit waters primarily seaward of the continental shelf and that dwarf sperm whales are "somewhat more coastal," occurring in shelf-edge and slope waters. In the northern Gulf of Mexico, sightings of dwarf and pygmy sperm whales occur primarily along the continental shelf edge and over the deeper waters off the continental shelf. These two species are virtually impossible to differentiate in the field.

Seasonal Distribution

Dwarf sperm whales and their cogeners, pygmy sperm whales, are often combined into a *Kogia* category because of the inability to differentiate the two species at sea. Sightings of *Kogia* spp. have been documented in all seasons in the northern Gulf of Mexico.

Pygmy Sperm Whale (*Kogia breviceps*)

Status

The population of pygmy sperm whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of pygmy sperm whales in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The pygmy sperm whale is distributed worldwide in temperate to tropical waters. Reeves et al. (2002) reported that pygmy sperm whales are thought to inhabit waters primarily seaward of the continental shelf and that dwarf sperm whales are "somewhat more coastal," occurring in shelf-edge and slope waters. In the northern Gulf of Mexico, sightings of dwarf and pygmy sperm whales occur primarily along the continental shelf edge and over the deeper waters off the continental shelf. These two species are virtually impossible to differentiate in the field.

Seasonal Distribution

Pygmy sperm whales and their cogeners, dwarf sperm whales, are often combined into a *Kogia* category because of the inability to differentiate the two species at sea. Sightings of *Kogia* spp. have been documented in all seasons in the northern Gulf of Mexico.

Melon-headed Whale (*Peponocephala electra*)

Status

The population of melon-headed whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of melon-headed whales in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. This Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

Melon-headed whales are distributed worldwide in tropical to sub-tropical waters (Reeves et al. 2002). In the northern Gulf of Mexico, sightings have occurred primarily in deeper waters off the continental shelf.

Seasonal Distribution

Sightings of melon-headed whales have occurred in all seasons in the northern GOM during NMFS surveys.

Risso's Dolphin (*Grampus griseus*)

Status

The population of Risso's dolphins in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of Risso's dolphins in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The Risso's dolphin is distributed worldwide in tropical and warm temperate waters (Reeves et al. 2002). Typically found in deep water (>1,000 m) on the upper continental slope, Risso's dolphins are known to move into more shallow water on the continental shelf, perhaps following prey. Sightings of this species in the northern GOM occurred primarily along the continental shelf and continental slope.

Seasonal Distribution

Sightings of Risso's dolphins have occurred in all seasons in the northern GOM during NMFS surveys. Mullin and Fulling (2004) report that in the northeastern GOM Risso's dolphins were three times more abundant in winter than in summer.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

Status

The population of short-finned pilot whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to

differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of short-finned pilot whales in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The short-finned pilot whale is widespread and abundant in warm temperate to tropical waters of the world (Reeves et al. 2002). Sightings of this species in the northern GOM occurred primarily along the continental shelf and continental slope.

Seasonal Distribution

Sightings of short-finned pilot whales have occurred in all seasons in the northern GOM during NMFS surveys.

Sperm Whale (*Physeter macrocephalus*)

Status

The population of sperm whales in the Gulf of Mexico constitutes a distinct stock from other Atlantic ocean stocks(s) (Jochens et al. 2008) and is considered as such for management purposes by NMFS. The status of sperm whales in the northern Gulf of Mexico is unknown (relative to the OSP). This species is listed under the Endangered Species Act and is the only commonly occurring marine mammal in the Gulf of Mexico with this status. Insufficient data prohibits determination of population trends. Sperm whales are designated as strategic because of their endangered status.

Distribution

Sperm whales are found worldwide in ice-free waters from the equator to the edges of the polar ice pack (Reeves et al. 2002). In the northern Gulf of Mexico, sperm whales are widely distributed throughout oceanic waters (>200 m). The highest densities of sperm whales in the Gulf are in the slope waters between 200 and 2,000 m deep (Mullin and Fulling, 2004). Mullin and Fulling (2004) report increased sightings of sperm whales off the Mississippi River delta, and in the southeastern Gulf, west of the Dry Tortugas. They speculate that these whale concentrations may be due to the primary productivity associated with the Mississippi River plume and the productivity bolstered by nutrient upwelling along the Loop Current front and periodic formations of cyclonic gyres in the southeast Gulf, respectively.

Seasonal Distribution

Sperm whales have been sighted in all seasons in the Gulf of Mexico on NOAA surveys. However, sightings have been more common during the summer months.

Bryde's Whale (*Balaenoptera edeni*)

Status

The population of Bryde's whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation and/or residency.

The status of Bryde's whales in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data

prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The Bryde's whale is distributed worldwide in tropical and subtropical waters (Reeves, et al. 2002). Species sightings in the northern Gulf of Mexico are not common and have almost exclusively occurred in the eastern Gulf. Mullin and Fulling (2004) reported that all four Bryde's whale sightings made on NOAA surveys between 1996 and 2001 were in northeastern Gulf slope waters (200 – 1,000 m).

Seasonal Distribution

Sightings of Bryde's whales have occurred in the northern Gulf of Mexico mainly during the spring-summer months; however, Jefferson et al. (1992) reported that strandings have occurred throughout the year.

Cuvier's Beaked Whale (*Ziphius cavirostris*)

Status

The population of Cuvier's beaked whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. Although inadequate biological information prohibits the differentiation on of Cuvier's beaked whale stock structure in the Gulf of Mexico from those in the Atlantic Ocean.

The status of Cuvier's beaked whales in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The Cuvier's beaked whale is distributed worldwide in deep offshore, tropical to cool temperate marine waters (Reeves et al. 2002). Species sightings in the northern GOM occurred primarily in the deep waters off the continental shelf.

Seasonal Distribution

Strandings of Cuvier's beaked whales have been recorded throughout the year in the northern GOM. During NMFS surveys, beaked whales were recorded in all seasons, but identifying the whales to the species level is difficult from aerial observations. Some of the aerial sightings may have been Cuvier's beaked whales.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

Three species of the genus *Mesoplodon* have been recorded in the Gulf of Mexico, based on sightings and strandings. These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), and Sowerby's beaked whale (*M. bidens*). The latter of these, Sowerby's beaked whale, is known in the Gulf from only one stranding record and is considered extralimital because of its typical range in the northern temperate waters of the North Atlantic. Identification of *Mesoplodon* species in the field is very difficult so these species are combined as beaked whales. This species grouping may also include some Cuvier's beaked whales that were not identified to species.

Status

The population of Blainville's beaked whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to

differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation and/or residency.

The status of Blainville's beaked whales in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends.. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The Blainville's beaked whale has widespread distribution in the tropical and warm temperate world oceans (Reeves et al. 2002). Sightings and stranding of this whale have been identified to the species level in the northern Gulf of Mexico. Beaked whale sightings in the Gulf have occurred primarily in the deep waters off the continental shelf.

Seasonal Distribution

Sightings of beaked whales have occurred in all seasons in the northern Gulf of Mexico during NMFS surveys.

Gervais' Beaked Whale (*Mesoplodon europaeus*)

Three species of the genus *Mesoplodon* have been recorded in the Gulf of Mexico, based on sightings and strandings. These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), and Sowerby's beaked whale (*M. bidens*). The latter of these, Sowerby's beaked whale, is known in the Gulf from only one stranding record and is considered extralimital because of its typical range in the northern temperate waters of the North Atlantic. Identification of *Mesoplodon* species in the field is very difficult so these species are combined as beaked whales. This species grouping may also include some Cuvier's beaked whales that were not identified to species.

Status

The population of Gervais' beaked whales in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation and/or residency.

The status of Gervais' beaked whales in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The Gervais' beaked whale appears to be distributed only in the tropical and warm temperate waters of the Atlantic Ocean (Reeves et al. 2002). Sightings and stranding of this whale have been identified to the species level in the northern Gulf of Mexico. Beaked whale sightings in the Gulf have occurred primarily in the deep waters off the continental shelf.

Seasonal Distribution

Sightings of beaked whales have occurred in all seasons in the northern Gulf of Mexico during NMFS surveys.

Bottlenose Dolphin (*Turisops truncatus*)

Status

Thirty-eight stocks of bottlenose dolphins are recognized by NMFS in the northern Gulf of Mexico for management purposes. These include 33 inshore stocks; 3 coastal stocks in the Eastern, Central and Western Gulf waters delineated as from the shore to 9 km seaward of the 10-fathom (18 m) contour; 1 outer continental shelf stock occurring from the coastal stock boundary to 9 km seaward of the 100-fathom (183 m) contour, and 1 continental shelf edge and slope stock occurring from the outer continental shelf boundary to the Exclusive Economic Zone (EEZ) boundary. These stocks may in fact overlap adjoining stocks in some areas and may be genetically indistinguishable from those stocks. The Gulf of Mexico bottlenose dolphin population consists of a coastal ecotype and an offshore ecotype.

The status of bottlenose dolphins in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends.. Both the oceanic and the continental shelf stocks are not considered strategic stocks because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR. However, the bay, sound and estuarine stocks (33) as well as the coastal stocks (3) are all considered strategic stocks due to documented cases of human mortality resulting in PBR being exceeded.

Distribution

Bottlenose dolphins are cosmopolitan marine mammals found in tropical and temperate oceans and peripheral seas. This species occupies a wide variety of habitats and is considered perhaps the most adaptable cetacean (Reeves et al. 2002). As shown by the numerous stocks mentioned above, this widespread species occurs throughout the Gulf of Mexico. Bottlenose dolphin habitat ranges from inshore bays and sounds to the deep waters of the continental slope. During NMFS oceanic surveys, bottlenose dolphins were seen primarily in water depths less than 1,000 m, and the highest density of this species was in northeastern Gulf slope waters (Mullin and Fulling, 2004). However, densities are similar between the eastern and western Gulf outer continental shelf waters. Bottlenose dolphins were also fairly evenly distributed between the coastal waters (< 20 m) and the outer continental shelf waters (20 to 200 m) (Fulling et al. 2003).

Seasonal Distribution

Sightings of bottlenose dolphins have occurred in all seasons in the northern GOM during NMFS surveys.

Atlantic Spotted Dolphin (*Stenella frontalis*)

Status

The population of Atlantic spotted dolphins in the Gulf of Mexico is being considered a separate stock for management purposes by NMFS. Recent information from Adams and Rosel (2005) suggested genetically this stock could be differentiated from North Atlantic stocks.

The status of Atlantic spotted dolphins in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. This is not a strategic stock because previous estimates of population size have been large compared to the number of cases of documented human-related mortality and serious injury.

Distribution

Atlantic spotted dolphins are one of two Gulf of Mexico dolphin species that occur only in the Atlantic Ocean (along with Clymene dolphins). Also, only this species and the bottlenose dolphin are commonly found in the shallower continental shelf waters (<200 m depth) of the Gulf (Mullin and Fulling, 2004). Atlantic spotted dolphins are primarily distributed in waters between 10 and 500 m in the

Gulf of Mexico and are not known to occur inshore. The density of Atlantic spotted dolphins is much greater in the eastern Gulf outer continental shelf waters that those of the western Gulf (Fulling et al. 2003).

Seasonal Distribution

Sightings of Atlantic spotted dolphins have occurred in all seasons in the northern GOM during NMFS surveys.

Pantropical Spotted Dolphin (*Stenella attenuatus*)

Status

The population of pantropical spotted dolphins in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, there is currently no information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of pantropical spotted dolphins in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

Pantropical spotted dolphins are found worldwide in all tropical to warm temperate waters between about 40°N and 40°S (Reeves et al. 2002). In the northern Gulf of Mexico, this species is widely distributed in deeper waters and is the most common cetacean in the oceanic northern GOM (Mullin et al. 2004; Wursig et al. 2000). The highest density for pantropical spotted dolphins is in the abyssal waters (> 2,000 m) but this species has been observed, though rarely, in the more shallow waters over the continental shelf (Mullin and Fulling, 2004).

Seasonal Distribution

Sightings of pantropical dolphins have occurred in all seasons in the northern GOM during NMFS surveys. However, Mullin and Fulling (2004) report that this species is two times more abundant in summer in the northeastern Gulf than in winter.

Striped Dolphin (*Stenella coeruleoalba*)

Status

The population of striped dolphins in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of striped dolphins in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The striped dolphin is cosmopolitan in distribution occurring in tropical and warm temperate waters (Reeves et al. 2002). In the northern Gulf of Mexico, sightings have occurred primarily in the deeper waters off the continental shelf (Mullin and Fulling, 2004).

Seasonal Distribution

Sightings of striped dolphins have occurred in all seasons in the northern GOM during NMFS surveys.

Spinner Dolphin (*Stenella longirostris*)

Status

The population of spinner dolphins in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of spinner dolphins in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

The spinner dolphin is distributed worldwide in temperate to tropical oceanic waters (Reeves et al. 2002). Sightings of spinner dolphins in the northern Gulf of Mexico have primarily occurred on the continental slope east of Mobile Bay (Mullin and Fulling, 2004).

Seasonal Distribution

Sightings of spinner dolphins have occurred in all seasons in the northern GOM during NMFS surveys.

Rough-toothed Dolphin (*Steno bredanensis*)

Status

The population of rough-toothed dolphins in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of rough-toothed dolphins in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. Despite an undetermined PBR, this is not a strategic stock because there is no documented human-related mortality and serious injury.

Distribution

The rough-toothed dolphin occurs in tropical and warm temperate waters globally (Reeves et al. 2002). In the northern Gulf of Mexico, sightings have occurred in both oceanic waters and in continental shelf waters (Fulling et al. 2003). This species may have a greater-than-expected presence in shelf waters (see Seasonal Distribution). Mullin and Fulling (2004) report that there may be similar numbers of rough-toothed dolphins in shelf waters as there are in oceanic waters.

Seasonal Distribution

Sightings of rough-toothed dolphins have occurred in all seasons in the northern GOM during NMFS surveys. Higher densities of rough-toothed dolphins were found in the fall in northern Gulf shelf waters than were found in oceanic waters in the spring (Fulling et al. 2003).

Clymene Dolphin (*Stenella clymene*)

Status

The population of clymene dolphins in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of clymene dolphins in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. The Gulf of Mexico stock is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

Distribution

Clymene dolphins are found only in the deep tropical and subtropical waters of the Atlantic Ocean, including the Gulf of Mexico and the Caribbean Sea (Reeves et al. 2002). This is one of the two species commonly occurring in the Gulf that are endemic to the Atlantic. In the northern Gulf of Mexico, sightings have occurred primarily over the deeper waters off the continental shelf and mostly west of Mobile Bay (Mullin and Fulling, 2004).

Seasonal Distribution

Clymene dolphins were sighted in all seasons except fall in the northern Gulf of Mexico during NMFS surveys.

Fraser's Dolphin (*Lagenodelphis hosei*)

Status

The population of Fraser's dolphins in the Gulf of Mexico is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of Fraser's dolphins in the northern Gulf of Mexico is unknown (relative to the OSP). This species is not listed under the Endangered Species Act as threatened or endangered and insufficient data prohibits determination of population trends. Despite an undetermined PBR, this is not a strategic stock because there is no documented human-related mortality and serious injury.

Distribution

Fraser's dolphins are found worldwide in tropical waters, primarily in water depths greater than 1,000 m (Reeves et al. 2002). In the northern Gulf of Mexico, sightings have occurred primarily over the deeper waters off the continental shelf.

Seasonal Distribution

Sightings of Fraser's dolphins have occurred in all seasons in the northern GOM during NMFS surveys.

(5) The Type of Incidental Taking Authorization that Is Being Requested (I.E., Takes by Harassment Only; Takes by Harassment, Injury and/or Death) and the Method of Incidental Taking;

The BOEMRE requests NMFS to promulgate regulations for any potential take (level A or level B harassment) of 21 species of marine mammals (described in Section 4 above), incidental to conducting seismic survey operations, regulated by the BOEMRE, in the northern Gulf of Mexico OCS planning areas. The permitted operations, as described in Sections 1 and 2 of this application, have the potential to

take marine mammals by harassment as defined by NMFS. NMFS current criterion for the onset of level B harassment (behavioral disturbance) for cetaceans is exposure to 160-179 dB re 1µ Pa rms for an impulse sound. The potential for incidental takes by level B harassment (probable risk of a behavioral response) during the use of airgun arrays is reasonably likely, thus warranting an authorization under section 101(a)(5)(A) of the MMPA.

Current NMFS policy is that the potential for permanent hearing damage (level A harassment – injury) for cetaceans exists at sound levels beginning at 180 dB re 1µ Pa rms and greater. The potential for acoustic injury exists from the proposed action, as typical seismic sources will exceed 180 dB re 1µ Pa rms close to the source. Since it remains unclear that the pulsed, low-frequency sound source resulting from airguns has actually caused injury to marine mammals in open water (National Research Council (NRC), 2003) or that marine mammals would not deflect away from sound intensities that could result in injury (MMS, 2004), the potential for injury is considered unlikely, but exposure to 180 dB re 1µ Pa rms or greater is possible. Due to slow vessel speed, mortality or serious injury of healthy marine mammals by seismic vessels is unlikely.

(6) By Age, Sex, and Reproductive Condition (If Possible), the Number of Marine Mammals (by Species) that May Be Taken by Each Type of Taking Identified in Paragraph (a)(5) of this Section, and the Number of Times Such Takings by Each Type of Taking Are Likely to Occur;

Anticipated takes as a result of seismic operation in the northern Gulf of Mexico OCS planning areas would be "takes by harassment" (Level B) mainly involving temporary changes in behavior. NMFS considers that take by harassment may occur at sound levels at or above 160 dB re 1 µPa (rms) for impulse sounds. This guideline does not consider the frequency component and nature of the sound source nor the hearing sensitivities of different cetacean species.

Similarly, at sound levels at or above 180 dB re 1 µPa (rms), NMFS has determined that the potential for physical damage to hearing exists. NMFS concluded in their June 29, 2007 Biological Opinion for the Five-Year Outer Continental Shelf Oil and Gas Leasing Program (2007-2012) in the Central and Western Planning Areas of the Gulf of Mexico that "the continued implementation of the impact minimization measures from seismic surveys in MMS's NTL is expected to reduce this harassment and to prevent this harassment from resulting in actual loss of individual sperm whales." The NTL referenced in this document is NTL 2007-G02 (*Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program*), and it requires shut-downs for all whales entering the exclusion zone. While these measures reduce the potential for injury, they do not entirely remove the possibility. Further, NTL 2007-G04 (*Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*) implements requirements for vessel operations in the vicinity of protected species therefore reducing and minimizing the potential for injury or mortality from vessel strikes.

No lethal takes are anticipated under this proposed action given the implementation of required mitigation and monitoring measures. There is, however, the potential to expose some animals to sound levels exceeding 180 dB re 1 µPa (rms) which would in turn potentially allow for temporary or permanent loss of hearing. Permanent Threshold Shift (PTS) is defined as the deterioration of hearing due to prolonged or repeated exposure to sounds which accelerate the normal process of gradual hearing loss (Kryter, 1985), or the permanent hearing damage due to brief exposure to extremely high sound levels (Richardson et al. 1995). PTS results in a permanent elevation in hearing threshold—an unrecoverable reduction in hearing sensitivity (Southall et al. 2007). Temporary threshold shifts (TTS) indicate a temporary and reversible loss of hearing that may last for minutes to hours. The duration of TTS depends on a variety of factors including intensity and duration of the stimulus. Therefore, animals suffering from TTS over longer time periods, such as hours or days, may be considered to have a change in a biologically significant behavior, as they could be prevented from detecting sounds that are biologically relevant, including communication sounds, sounds of prey, or sounds of predators.

BOEMRE anticipates any risks for PTS (Level A harassment) or TTS (i.e., Level B harassment) from seismic survey sound exposure, although possible, are likely minimized given:

- the implementation of mitigation and monitoring measures expanded from that required under NTL 2007-G02 (e.g., establishment of an exclusion zone, shutdowns, protected species observer program) which are designed to avoid large whale (as low or mid frequency specialists have hearing ranges with the greater potential for overlap with seismic noise) exposure to sound levels equal to or greater than 180 dB re 1 µPa (rms)
- the most recent scientific information (Southall et al, 2007) estimates the actual onset for acoustic injury from multi-pulse sources (i.e., seismic survey sound sources) to be 230 dB re 1 µPa (flat) rather than 180 dB re 1 µPa (rms);
- the required mitigation and monitoring measures, based on avoiding sound exposure levels of greater than 180 dB re 1 µPa (rms), are therefore considered conservative.

The number of marine mammals, by species, estimated to be exposed to these "take thresholds" has been calculated for seismic activities using best available data and assumptions as outlined below and provided in detail in Appendix A (MAI, 2010) of this request. Because of numerous data limitations and uncertainties in assessing acoustic effects on cetaceans, the best estimate of marine mammal density for a geographic location is used to predict a possible number of animals within a given distance of a sound source. Those animals within calculated isopleths of sound above 160 dB re 1 µPa (rms) are considered a take. This basic rationale (independent of uncertainties in numbers) probably overestimates actual take numbers (exposure of an animal to a sound is not necessarily equivalent to the animal being taken).

The basic data elements used to estimate incidental take include: summary of seismic survey activity levels derived from recent BOEMRE survey records, estimates of future effort from the seismic industry and the best available marine mammal density estimates for the GOM based on the Navy OPAREA Density Estimates (NODE) database (DoN, 2007b) (which were derived from the NMFS-SEFSC shipboard surveys conducted between 1994 and 2006).Take estimates for each of the five types of seismic activity (OBS, 2-D, 3-D, WAZ, and 2-D High Resolution) have been divided into nine basic areas based on shallow (< 200 m depth), slope (200-1000 m) and deep water ($\geq$ 1000 m) portions of the three OCS planning areas of the Gulf of Mexico (western-WPA, Central-CPA, Eastern-EPA) (see Figure 2-1).

Due to the large number of surveys and survey types in the GOM, precise calculations associated with specific airgun arrays are impractical. Nor is it possible to develop a projection of exactly what distribution of possible arrays will be used in the future. Instead, a "typical deep seismic array" has been defined based on an analysis of airguns utilized in Gulf of Mexico operations. The defined array is a 4,550-in³ airgun array with a 240 dB zero to peak and 230 dB rms. Actual array output varies by seismic survey type and can be considerably higher or lower depending on the number of arrays and airguns used. This could result in an increase or decrease of the ensonification area. In non-commercial operations, array size can vary and be considerably larger, such as the Lamont-Doherty Earth Observatory's 6,600 in^3 36-gun array used on the R/V *Marcus G. Langseth* (Tolstoy et al. 2009).

It is known that a seismic signal is comprised primarily of low-frequency components with a peak of 50- 60 Hz, but also has contributions from both mid- and high-frequency components. It is also known that the area of ensonification, when viewed from above is a somewhat irregular isopleth when actually measured but more closely approximates an elliptical shape rather than a circle (MMS, 2004). Take estimates for each marine mammal species were calculated using the AIM model (see Appendix A for details) and then incorporating both NMFS standard thresholds as well as Level A thresholds from the findings in Southhall et al. (2007).

Using detailed modeling of the source and its properties, the acoustic propagation field in three dimensions, and three dimensional animal placement and movement to better calculate the potential impacts to marine mammals take estimates were calculated for each species. This included different types of seismic activity with differing sources levels, different water depths (shallow, slope, and deep) and different OCS planning areas. For this methodology, the first step is largely controlled by properties of the source, such as its movement in time and space, and the sound field it generates at any point in time. Propagation modeling further analyzes the effects of the physical properties of the ocean, the bottom and the surface on the sound field as it propagates out from the source. The second step requires knowledge of the diving and movement characteristics of the animals residing in the exposed region. Time-based integration models, such as the Acoustic Integration Model© (AIM) developed by Marine Acoustics, Inc., as used in this modeling effort, are necessary to fully evaluate the exposure. AIM is a

software package developed to predict the acoustic exposure of marine animals from an underwater sound source. The unique and principal component of AIM is a 3-D movement engine, which programs the geographic and vertical movements of sound sources and simulated marine animals. In this MMPA application, BOEMRE is providing Level A and Level B harassment take estimates using AIM and incorporating both standard Level A harassment (Table 6-1) as well as Level A using Southall et al. (2007) (Table 6-2). For Level B harassment, BOEMRE is using the 160 dB that has been standard for NMFS. BOEMRE believes that using AIM, including Southall et al. (2007) is based on the best scientific information available.

In 2006, the Center for Independent Experts (CIE) conducted a review and assessment of AIM. The CIE panel concluded that AIM is a credible tool for developing application models (Independent System for Peer Review 2006). The advantage of these tools is that they not only provide a more accurate and detailed model of the exposures of a population of marine animals in the three dimensions and time, but they also provide: 1) statistical data on each individually modeled animal and the population as a whole; 2) rate of exposure (sounds per unit time) over the duration of a survey; and 3) the data necessary to determine effects based on more sophisticated thresholds, such as sound exposure level, SEL.

Table 6-1. Estimates of Potential Level A and B Harassment Impacts Using AIM Methodology and Standard Thresholds.

	Level A (180 dB)						Level B (160 dB)					
Marine Mammal Species	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Mysticetes												
Bryde's whale	2.1	1.9	2.0	2.1	0.03	0.03	60.4	42.0	12.8	21.7	118.1	100.1
Odontocetes												
Atlantic spotted dolphin	6647.8	1984.1	282.9	1007.0	9841.7	8034.4	126106.7	35502.2	4394.8	17996.7	182775.1	149084.9
Beaked whales:	77.5	66.7	16.3	29.8	159.1	132.1	1870.5	1434.4	443.0	751.2	3745.4	3184.4
Cuvier's												
Blainesville's												
Gervias'												
Bottlenose dolphin	27925.6	11629.0	1787.0	6229.0	58691.6	47999.2	265774.6	118531.9	26384.7	63431.7	460514.0	379802.9
Clymene dolphin	3109.1	2541.3	771.7	1273.6	6190.4	5257.8	24927.4	17229.8	4301.4	8025.3	49496.3	41423.1
False Killer whale	215.3	176.1	46.5	82.4	442.6	372.3	2635.2	2043.2	676.6	1084.1	5117.4	4383.0
Fraser's dolphin	162.7	130.3	40.4	65.4	323.1	274.5	1460.3	1019.0	308.4	524.7	2831.6	2401.1
Killer whale	820.3	322.1	78.4	167.5	1119.8	928.2	21418.8	7891.6	1628.0	3944.1	29273.6	24126.7
Kogia spp.	266.0	271.6	77.1	124.7	532.3	453.8	1336.3	1280.3	502.9	728.0	2399.1	2119.6
Dwarf sperm whale												
Pygmy sperm whale												
Melonheaded whale	754.8	614.1	158.1	283.4	1555.4	1306.1	8849.5	6811.8	2252.7	3613.8	17122.8	14659.7
Pantropical spotted dolphin	25073.7	18969.7	5523.1	9816.7	51802.1	43606.2	215647.6	148395.2	39765.9	76291.2	441142.2	367083.6
Pygmy killer whale	85.5	72.7	19.7	34.0	176.9	148.9	990.7	762.4	250.7	400.7	1922.9	1649.1
Risso's dolphin	1280.0	828.0	190.8	404.8	2716.9	2246.6	9687.2	6199.2	1853.9	3432.2	19862.9	16684.0
Rough-toothed dolphin	987.8	655.6	129.1	290.1	2030.8	1681.9	9840.8	7226.6	1970.8	3431.7	18032.3	15251.0
Short-finned pilot whale	442.7	372.3	101.3	173.7	900.9	760.0	6115.1	4689.3	1530.4	2469.7	11921.1	10201.7
Sperm whale	217.1	167.7	52.0	90.3	442.6	372.3	2377.2	1833.5	605.6	979.6	4684.7	4015.7
Spinner dolphin	4643.3	3273.3	1202.6	1975.6	8762.5	7466.9	68655.0	34767.6	8648.8	19246.0	139045.2	115052.4
Striped dolphin	5458.3	1924.1	683.2	1100.1	4122.8	3550.9	19240.6	12572.3	3592.8	6600.5	38143.7	31999.1

Table 6-2. Estimates of Potential Level A and B Harassment Impacts Using AIM and Historic Thresholds with Southall et al (2007) Applied.

	Level A (SPL-230, SEL-215 dB)						Level B (160 dB)					
Marine Mammal Species	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Mysticetes												
Bryde's whale	0.02	0.03	0.03	0.03	0.03	0.03	60.4	42.0	12.8	21.7	118.1	100.1
Odontocetes												
Atlantic spotted dolphin	69.6	49.3	19.1	23.2	123.4	100.9	126106.7	35502.2	4394.8	17996.7	182775.1	149084.9
Beaked whales:	0.1	0.1	0.1	0.1	0.1	0.1	1870.5	1434.4	443.0	751.2	3745.4	3184.4
Cuvier's												
Blainesville's												
Gervias'												
Bottlenose dolphin	1010.2	426.2	65.9	234.8	2182.5	1785.8	265774.6	118531.9	26384.7	63431.7	460514.0	379802.9
Clymene dolphin	278.1	224.6	67.3	109.0	539.2	460.8	24927.4	17229.8	4301.4	8025.3	49496.3	41423.1
False Killer whale	3.2	2.6	3.0	3.0	2.5	3.4	2635.2	2043.2	676.6	1084.1	5117.4	4383.0
Fraser's dolphin	2.9	2.7	2.9	3.1	2.8	3.6	1460.3	1019.0	308.4	524.7	2831.6	2401.1
Killer whale	32.0	11.5	1.0	4.6	45.7	37.4	21418.8	7891.6	1628.0	3944.1	29273.6	24126.7
Kogia spp.	0.8	0.5	0.7	0.6	0.4	0.7	1336.3	1280.3	502.9	728.0	2399.1	2119.6
Dwarf sperm whale												
Pygmy sperm whale												
Melonheaded whale	12.6	17.2	12.3	12.8	10.8	13.1	8849.5	6811.8	2252.7	3613.8	17122.8	14659.7
Pantropical spotted dolphin	1045.9	864.7	365.0	520.2	1835.1	1609.2	215647.6	148395.2	39765.9	76291.2	441142.2	367083.6
Pygmy killer whale	1.0	0.7	0.9	0.8	0.6	0.9	990.7	762.4	250.7	400.7	1922.9	1649.1
Risso's dolphin	1.7	1.6	1.7	1.5	1.4	1.6	9687.2	6199.2	1853.9	3432.2	19862.9	16684.0
Rough-toothed dolphin	1.9	2.0	1.5	1.7	1.6	1.4	9840.8	7226.6	1970.8	3431.7	18032.3	15251.0
Short-finned pilot whale	7.6	9.3	7.4	7.4	6.1	8.3	6115.1	4689.3	1530.4	2469.7	11921.1	10201.7
Sperm whale	19.1	13.9	3.6	6.8	40.7	33.8	2377.2	1833.5	605.6	979.6	4684.7	4015.7
Spinner dolphin	394.1	256.1	69.7	132.8	782.0	650.5	68655.0	34767.6	8648.8	19246.0	139045.2	115052.4
Striped dolphin	189.4	162.4	53.0	83.6	356.6	305.8	19240.6	12572.3	3592.8	6600.5	38143.7	31999.1

(7) The Anticipated Impact of the Activity Upon the Species or Stock;

The potential effects of noise on marine mammals can be either behavioral or physiological or both (For more information see Gordon et al. 2003, references therein and MMS (2004)). Of the 21 species of cetaceans found regularly occurring in the Gulf of Mexico, only one, the Bryde's whale (*Balaenoptera edeni*), makes low-frequency vocalizations, while all others vocalize in the mid-frequency range. The potential impacts of seismic surveys on mysticetes and odontectes are discussed below.

Mysticetes

The only commonly occurring baleen whale in the northern Gulf of Mexico is the Bryde's whale (*Balaenoptera edeni*). Baleen whale hearing sensitivity overlaps with maximal seismic airgun output. This puts them at greatest risk of auditory impacts from seismic sounds as many of their vocalizations overlap the maximum frequency range of energy output of a typical airgun array. Potential impacts include auditory impacts (hearing loss, injury, and discomfort), masking of important low-frequency sounds (communication, etc.) and changes in behavior are all possible as a result of seismic sounds.

Although there have been no studies of the reaction of Bryde's whale to seismic activities, it is generally considered that the auditory abilities of all mysticete species are broadly similar, based upon vocalization frequencies and ear anatomy (Ketten, 1998). Limited data on Bryde's whale reactions to other anthropogenic disturbances suggest little response to slowly approaching boats (Watkins, 1981), and that this species, like others, also appears to be easier to approach when feeding (Gallardo et al. 1983).

The synthesis of the behavioral response studies on mysticete whales indicates that the onset of significant behavioral disturbances from seismic-generated noise for migrating bowhead whales occurs at received levels (RMS over pulse duration) of ~120 dB re 1 µPa, while gray, blue, humpback, and feeding bowhead whales experience onset around 150 to 160 dB re 1 µPa (Southall et al. 2007). Bowhead whales exhibited responses to seismic airguns that included an avoidance response, at distances as great as 20 km around seismic surveying (where received levels were estimated to be approximately 117-135 dB re 1 µPa rms (Richardson et al. (1999), as well as changes in swimming and breathing (Richardson et al. 1986, 1999; Ljungblad et al. 1988), although feeding bowheads did not exhibit avoidance responses even when airguns were as close as 6 km (Miller et al. 2005). Malme et al. (1983, 1984) found that migrating gray whales exhibit avoidance responses to received levels greater than 160 dB re 1 µPa. Those gray whales that reacted generally slowed, turned away from the noise source, and increased their respiration rates (Richardson et al. 1995). For migrating humpback whales, an avoidance response begins at ~150 dB re 1 µPa (peak-to-peak) while general avoidance occurs at ~168 dB re 1 µPa (peak-to-peak) (McCauley et al. 1998). McDonald et al. (1995) observed that blue whales stopped vocalizing at an estimated 143 dB re 1 µPa (peak-to-peak) received level that occurred about 10 km from the seismic vessel and changed course to avoid closing on the seismic vessel.

The other baleen whales that have been sighted in the GOM are either considered rare or extralimital by Waring et al. (2009). These are the northern right whale, minke whale, sei whale, blue whale, fin whale, and humpback whale. If individuals of any of these species are sighted, special mitigation measures would apply due to their rarity and sensitivity. Airgun arrays would be shut down (not just powered down) if any of these species is sighted from the vessel. In case of confirmed sightings of any of these species, airgun operations would not resume until 30 min after the last documented whale visual sighting and the protected species observer (PSO) is confident that the whale is no longer in the vicinity of the vessel.

Odontocetes

There are a large number of odontecete species in the GOM. Their hearing thresholds are highly varied and species-specific. Many of these species are sensitive to high frequency sounds due to their use of high frequency sound pulses for echolocation and communication. Their sensitivity to low frequency sounds appears to be relatively poor, though low frequency hearing has not been extensively studied in

odontocetes. Seismic sounds are predominately low frequency (<200 Hz), though airgun arrays also produce energy at higher frequencies that may negatively impact some delphinid species. Potential impacts include auditory impacts (hearing loss, injury, and discomfort) as well as modification of some behaviors (avoidance, vocalizations).

Only a limited number of studies have been conducted on behavioral responses of odontocetes to seismic noise. Sperm whale behavioral responses have been the best studied of the odontocetes, although limited work on dolphin and beluga whales has also been conducted. The available data on odontocete behavioral responses to the underwater noise generated by seismic airguns and arrays, even for the same species, do not indicate clear response patterns. For instance, low received levels (~80 to 90 dB re 1 µPa) temporarily caused sperm whales to stop vocalizing, while received levels of 120 to 180 dB re 1 µPa did not cause noticeable behavioral reactions from sperm whales (Southall et al. 2007).

Sperm Whales

There is a reasonable potential that seismic surveys are exposing sperm whales to noise levels that may cause behavioral disturbance. The most probable disturbance is whales avoiding (moving away from) a seismic vessel. The degree of displacement, length of time involved, and types of normal activities interrupted would influence the significance of this disturbance. Less likely, but possible, are sperm whales remaining within acoustic exposure levels that will cause temporary hearing impairment or permanent hearing damage. This outcome would require whales to lack the ability to detect harmful sound intensities, "ignore" the signal in favor of other behavior such as feeding, or be in close proximity to a sudden start-up of airguns. The environment is deep, open waters. Short of a physically impaired whale, no physical constraints to "trap" a whale near a seismic sound source exist. Mitigation measures now in place remove sudden start-up as a possibility and observers with shut-down procedures substantially reduce the possibility of intense exposures. However, a deep-diving whale could be exposed to >180 dB signal intensities if the airgun array passes over the whale and the whale does not respond to (avoid) the increasing intensity.

There is an apparent concentration of whales located on the continental slope offshore of the Mississippi River mouth (and extending east to the DeSoto Canyon area in the Eastern Planning Area). Although sperm whales apparently are not being displaced from this area because of seismic surveys, it is unknown whether their site fidelity reflects low sensitivity to seismic noise or a high motivation to remain in the area in spite of this noise. Weir (2008) found few obvious visible responses of sperm (and humpback) whales to seismic airgun sounds off Angola, however only overt responses were examined.

From 2002-2005, BOEMRE funded a multi-year, interdisciplinary study on sperm whales in the GOM, called the Sperm Whale Seismic Study (SWSS). A summary report (OCS Study, MMS 2006-034) was produced in 2006 (Jochens et al. 2006), and a synthesis report (OCS Study, MMS 2008-006) was released in 2008 (Jochens et al. 2008). These reports provide the following conclusions regarding sperm whales in the GOM and their response to seismic surveys:

- During controlled exposure experiments (CEEs), researchers could detect "no horizontal avoidance of the seismic source for exposure levels (RLs) of <150 dB re 1 µPa (rms)." Similarly, opportunistic studies detected no apparent horizontal avoidance or displacement of sperm whales associated with operational seismic surveys;
- The CEE data results do not support the assumption that whales swim away from an airgun as it ramps up or approaches the whale at full power;
- In contrast to the lack of avoidance response, the CEE results showed there may be statistically significant changes in the swimming and foraging behavior of sperm whales exposed to the sound of airguns in the exposure range (RL) of 111 to 147 dB re 1 µPa (rms) (131 to 164 dB re 1 µPa [peak to peak]; see Table I in Madsen et al. 2006) at distances of approximately 1.4 – 12.6 km from the sound source; and
- There was the "discovery of a statistically significant 60% reduction in foraging for one whale coupled with evidence that other whales are less sensitive…"

(8) The Anticipated Impact of the Activity on the Availability of the Species or Stocks of Marine Mammals for Subsistence Uses;

Not applicable - There are no subsistence uses of marine mammals in the northern Gulf of Mexico.

(9) The Anticipated Impact of the Activity Upon the Habitat of the Marine Mammal Populations, and the Likelihood of Restoration of the Affected Habitat;

The majority of seismic operations anticipated will involve no more than a passing vessel introducing an elevated sound level into the water column. Adjacent areas may be exposed to pulsed sound over several days during the course of a survey; however, a continuous repetition of seismic operations in the same local habitat over months or years does not typically occur. No lasting modification or alteration of the habitat will occur. Immediate avoidance of the vessel (short-term, local displacement) may occur, but this situation does not represent loss of habitat.

There is no residual chemical or physical alteration of the habitat. The intensity of seismic sound sources would most likely injure or kill small organisms within a meter or so of an airgun or airgun array. Hearing damage to fish and, more so, behavioral alterations can occur in extended radii surrounding the sound source, likely on the same order as potential Level B takes at 160 dB re 1 µPa (rms) (LGL, 2003).

Habitat impacts, at most, will be some possible injurious effects on fish and planktonic organisms in close proximity to an airgun array and a greater area of possible behavioral responses. These are short-term impacts. Alteration of the habitat is minimal; restoration of the affected habitat to a pre-seismic state is rapid.

One exception to this type of operation would be proposed "4-D" survey using either fixed nodes/cables or repeated seismic surveys conducted over months to years. Some local benthic disturbance resulting from laying of nodes or cables. A negligible disturbance of sediments and benthic organisms will occur in these instances.

Even in this case, "repeated seismic operations" represent a geographically local area on the order of one lease block at most, and repetition is on the order of several days of firing airguns separated by several weeks to months of no activity.

(10) The Anticipated Impact of the Loss or Modification of the Habitat on the Marine Mammal Populations Involved;

Beyond a possible immediate, local avoidance of seismic operations, no habitat loss or modification is anticipated. Studies of the effects of seismic surveys have focused almost exclusively on the effects on individual species or related groups of species, with little attention being given to broader community-level issues. Parente et al. (2007) suggested that the diversity of cetaceans near the Brazil coast was reduced during years with seismic surveys. However, a preliminary account of a more recent analysis suggests that the trend did not persist when additional years were considered (Britto and Silva Barreto 2009). There are no anticipated impacts to marine mammal populations through loss or modification of habitat.

(11) The Availability and Feasibility (Economic and Technological) of Equipment, Methods, and Manner of Conducting Such Activity or Other Means of Effecting the Least Practicable Adverse Impact Upon the Affected Species or Stocks, Their Habitat, and on Their Availability for Subsistence Uses, Paying Particular Attention to Rookeries, Mating Grounds, and Areas of Similar Significance;

The current mitigation suite, which is effective in all Federal waters in the Eastern Planning Area and in Federal waters >200 m depth in the Central and Western Planning Areas, includes ramp-up, visual monitoring by trained observers, establishment of an impact zone (currently 500 m around the sound source), and mandatory "shut-down" to avoid injury to large whales in or about to enter the impact zone. Detailed descriptions of mitigations are provided in NTL 2007-G02 and this is attached as an Appendix to this application. Each of these helps ensure the least practicable adverse impact for certain marine mammal species. Ramp-up, or soft start, requires seismic operators to start firing the acoustic array with one gun and gradually over time add more guns until the array is fully operational. This allows cetaceans

in the area to move away from the sound source before discomfort or injury might result. Visual observers monitor the area around the sound source for 30 minutes prior to ramp-up and throughout seismic operations. Any time a whale enters or surfaces within 500 m of the sound source, seismic transmissions are immediately ceased in order to minimize as much as possible the exposure of the whales to potentially damaging levels of sound. A protected species observer program is currently in place requiring trained observers on all seismic vessels. Enhanced monitoring and reporting is also required under the latest seismic NTL. Again, for more detail on mitigations currently in effect, please see BOEMRE Notice to Lessees NTL 2007-G02.

Although not presently required, but encouraged under the NTL, the voluntary use of passive acoustic monitoring (PAM) is becoming more common. Using PAM in an operational setting allows ramp-up and the subsequent start of a seismic survey during times of reduced visibility (darkness, fog, rain, etc.) when such ramp-up otherwise would not be permitted using only visual observers. Research during the Sperm Whale Seismic Study (SWSS) also provided recommendations for improved PAM technology in the GOM. In November of 2009, BOEMRE hosted a workshop "*Status and Applications of Acoustic Mitigation and Monitoring Systems for Marine Mammals.*" This workshop focused on the capabilities, applicability, feasibility and availability of current acoustic monitoring systems. The presentations and background materials can be found at: http://www.acousticmonitoring.org/index.html and the complete proceedings will be available in the next few months.

Alternative technologies could be used to minimize or reduce the amount of sound introduced into the marine environment during seismic surveys. Methods of either reducing sound from existing technology as well as new alternatives to airguns are discussed in detail in symposia from a recently held workshop "Alternative Technologies to Seismic Airgun Surveys for Oil and Gas Exploration and their Potential for Reducing Impacts on Marine Mammals" Weilgart (2010). Participants in this 2009 workshop examined quieter, potentially less harmful technologies that might be able to, at least partially, replace airguns. Technologies discussed included controlled source electromagnetics, marine vibrators, and modifications to existing airgun technologies to reduce unwanted energy.

(12) Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse affects on the availability of marine mammals for subsistence uses;

Not applicable - There are no subsistence uses of marine mammals in the northern Gulf of Mexico.

(13) The Suggested Means of Accomplishing the Necessary Monitoring and Reporting that Will Result in Increased Knowledge of the Species, the Level of Taking or Impacts on Populations of Marine Mammals that Are Expected to Be Present while Conducting Activities and Suggested Means of Minimizing Burdens by Coordinating Such Reporting Requirements with Other Schemes Already Applicable to Persons Conducting Such Activity. Monitoring Plans Should Include a Description of the Survey Techniques that Would Be Used to Determine the Movement and Activity of Marine Mammals Near the Activity Site(S) Including Migration and Other Habitat Uses, Such as Feeding;

Current monitoring and reporting requirements are set forth in BOEMRE's Notice to Lessees and Operators of Federal Oil, Gas, and Sulphur Leases in the Outer Continental Shelf, Gulf of Mexico OCS Region (NTL 2007-G02): *Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program*. The NTL applies to seismic surveys in all water depths in the Eastern Planning Area of the GOM and in water depths greater than 200 m in the rest of the GOM. Reporting is required from all working seismic vessels in the GOM on a bi-weekly basis. Sightings are reported on the 1st and 15th of each month, and any shut-downs must be reported to BOEMRE within 24 hours.

An annual report summarizing all sperm whale and sea turtle sightings is submitted by BOEMRE to the National Marine Fisheries Service (NOAA Fisheries) Southeast Regional Office. This reporting requirement was made as part of the conservation recommendations in NMFS' Biological Opinion (August 30, 2003) for the Gulf of Mexico Outer Continental Shelf Oil and Gas Lease Sales 189 and 197.

Monitoring during seismic surveys requires visually-oriented Protected Species Observers (PSOs). At least two protected species visual observers are required on watch aboard seismic vessels at all times during daylight hours (nautical twilight-dawn to nautical twilight-dusk) when seismic operations are being conducted, unless conditions (fog, rain, darkness) make sea surface observations impossible. If conditions deteriorate during daylight hours such that the sea surface observations are halted, visual observations must resume as soon as conditions permit. Operators currently may engage trained third party observers, may utilize crew members after training as observers, or may use a combination of both third party and crew observers. During these observations, the following guidelines shall be followed: (1) other than brief alerts to bridge personnel of maritime hazards, no additional duties may be assigned to the observer during his/her visual observation watch (if conditions warrant more vigilant look-outs when navigating around or near maritime hazards, additional personnel must be used to ensure that watching for protected species remains the primary focus of the on-watch observers), (2) no observer will be allowed more than 4 consecutive hours on watch as a visual observer, (3) a "break" time of no less than 2 hours must be allowed before an observer begins another visual monitoring watch rotation (break time means no assigned observational duties), and (4) no person (crew or third party) on watch as a visual observer will be assigned a combined watch schedule of more than 12 hours in a 24-hour period. Due to the concentration and diligence required during visual observation watches, operators who choose to use trained crew members in these positions are encouraged to select only those crew members who demonstrate willingness as well as ability to perform these duties.

All visual observers must have completed a protected species observer training course. The BOEMRE does not sanction particular trainers or training programs. However, basic training criteria have been established and must be adhered to by any entity that offers observer training (NTL 2007-G02). Operators may utilize observers trained by third parties, may send crew for training conducted by third parties, or may develop their own training program.

Visual Monitoring Methods

The observers on duty will look for whales, other marine mammals, and sea turtles using the naked eye and hand-held binoculars. Observers will stand watch in a suitable location that will not interfere with navigation or operation of the vessel and that affords the observers an optimal view of the sea surface. The observers will provide 360° coverage surrounding the seismic vessel and will adjust their positions appropriately to ensure adequate coverage of the entire area. These observations must be consistent, diligent, and free of distractions for the duration of the watch.

Visual monitoring will begin no less than 30 minutes prior to the beginning of ramp-up and continue until seismic operations cease or sighting conditions do not allow observation of the sea surface (e.g., fog, rain, darkness). If a marine mammal (whale or dolphin) or sea turtle is observed, the observer should note and monitor the position (including lat./long. of vessel and relative bearing and estimated distance to the animal) until the animal dives or moves out of visual range of the observer. Make sure to continue to observe for additional animals that may surface in the area, as often there are numerous animals that may surface at varying time intervals. At <u>any</u> time a whale is observed within an estimated 500 m of the sound source array ("exclusion zone"), whether because of the whale's movement, the vessel's movement, or because the whale surfaced inside the exclusion zone, the observer will call for the immediate shut-down of the seismic operation and airgun firing (the vessel may continue on its course but all airgun discharges must cease). The vessel operator must comply immediately with such a call by an on-watch visual observer. Any disagreement or discussion should occur only after shut-down. When no whales are sighted for at least a 30-minute period, ramp-up of the source array may begin. Ramp-up cannot begin unless conditions allow the sea surface to be visually inspected for whales for 30 minutes prior to commencement of ramp-up (unless the method described in the section entitled "Experimental Passive Acoustic Monitoring" is used). Thus, ramp-up cannot begin after dark or in conditions that prohibit visual inspection (fog, rain, etc.) of the exclusion zone. Any shut-down caused by a whale(s) sighting within the exclusion zone must be followed by a 30-minute all-clear period and then a standard, full ramp-up. Any shut-down for other reasons, including, but not limited to, mechanical or electronic failure, resulting in the cessation of the sound source for a period greater than 20 minutes, must also be followed by full ramp-up procedures. In recognition of occasional, short periods of the cessation of airgun firing for a variety of reasons, periods of airgun silence not exceeding 20 minutes in duration will not require ramp-up for the resumption of seismic operations if: (1) visual surveys are continued diligently throughout the silent period (requiring daylight and reasonable sighting conditions); and (2) no whales, other marine mammals, or sea turtles are observed in the exclusion zone. If whales, other marine mammals, or sea

turtles are observed in the exclusion zone during the short silent period, resumption of seismic survey operations must be preceded by ramp-up.

Experimental Passive Acoustic Monitoring

Whales, especially sperm whales, are very vocal marine mammals, and periods of silence are usually short and most often occur when these animals are at the surface and may be detected using visual observers. However, marine mammals may be at greatest risk of potential injury from seismic airguns when they are submerged and under the airgun array. Passive acoustic monitoring appears to be very effective at detecting submerged and diving sperm whales, and some other marine mammal species, when they are not detectable by visual observation. The BOEMRE strongly encourages seismic operators to participate in an experimental program by including passive acoustic monitoring as part of the protected species observer program. Inclusion of passive acoustic monitoring does not relieve an operator of any of the mitigations (including visual observations) in the NTL with the following exception: Monitoring for whales with a passive acoustic array by an observer proficient in its use will allow ramp-up and the subsequent start of a seismic survey during times of reduced visibility (darkness, fog, rain, etc.) when such ramp-up otherwise would not be permitted using only visual observers. If passive acoustic monitoring is used you must include an assessment of the usefulness, effectiveness, and problems encountered with the use of the method of marine mammal detection in the reports described in the NTL.

Reporting

Three reports are submitted on the 1st and the 15th of each month: observer effort, survey, and sighting reports. The observer effort report is prepared for each day during seismic operations and includes information about when visual surveys were conducted as well as the average environmental conditions during the surveys. Survey reports (also prepared daily) include information about ramp-up activities, marine mammal observations made during ramp-up activities, and the duration and intensity of airgun activity. Sighting reports are made only when a marine mammal or sea turtle is observed. Data include the species observed, number of individuals (including juveniles), the animal's behavior (noting any observed changes), closest distance of the animal(s) to the airguns, and whether or not the airguns were firing at the time of the observation. In the event that the sighting was of a whale(s) within the exclusion zone that resulted in a shut-down of the airguns, the report must include the observed behavior of the whale(s) before shut-down, the observed behavior following shut-down (specifically noting any change in behavior), and the length of time between shut-down and subsequent ramp-up to resume the seismic survey (note if seismic survey was not resumed as soon as possible following shutdown). The report is sent to BOEMRE within 24 hours of the shut-down.

(14) Suggested Means of Learning of, Encouraging, and Coordinating Research Opportunities, Plans, and Activities Relating to Reducing Such Incidental Taking and Evaluating Its Effects.

The BOEMRE has long taken a lead in evaluating the potential effects of industry related noise on marine mammals. Beginning in the mid-1970's, BOEMRE (then Bureau of Land Management) contracted for studies on the effects of noise on marine mammals in the Alaska and Pacific OCS Regions. In 1987, BOEMRE (then MMS) awarded a contract to LGL Ltd to prepare a comprehensive review of all literature with emphasis on the effects of noise from oil industry activities. In 1992, the Office of Naval Research (ONR) agreed to provide core funding to convert the MMS report into an expanded manuscript suitable for commercial publication. "*Marine Mammals and Noise*" by Richardson et al. (1995) was published by Academic Press through ONR and MMS/BOEMRE funding support.

In 1999, MMS funded a workshop on protected species issues in the Gulf of Mexico (McKay et al. 2001). Following presentations on issues, comments from a panel of eight experts, and public comment, a post-workshop meeting was held with the expert panel and other Federal representatives to discuss research priorities. One outcome, based on strong and clear recommendations for the workshop experts, was to modify an existing agreement with NMFS to conduct cetacean surveys to also explore methods to study acoustic impacts with the emphasis on effects of airguns on sperm whales. The Sperm Whale Acoustic Monitoring Program (SWAMP) began in June 2000 with joint support from MMS, ONR, and NMFS. The two-year pilot program effectively established new methods to study acoustic impacts and baseline whale behavior, including use of digital tags (D-tags), satellite tags (S-tags), passive acoustics,

and team coordination to effectively track whales through visual and acoustic methods, and direct small boats to tag whales.

With success on developing tools and methods, a directed study to evaluate the effects of seismic operations on sperm whales began in 2002. The Sperm Whale Seismic Study (SWSS) included support from BOEMRE, Office of Naval Research, National Science Foundation (NSF), and a coalition of seismic and oil industry funders. The SWSS further coordinated with related industry research in initiatives and ongoing NMFS Gulf of Mexico cetacean surveys co-funded by the Navy (N-45). Further, BOEMRE has supported acoustic research through the National Oceanographic Partnership Program (NOPP).

Field work for SWSS was completed in 2005 and a final synthesis report was produced in 2008 (MMS 2008-006). Recommendations from this project included continued data collection of basic population biology parameters including breeding/calving, feeding and foraging and prey species identification. In 2009, BOEMRE through an interagency agreement with NMFS began the Sperm Whale Acoustic Prey Study (SWAPS) which will characterize the prey base for sperm whales in the GOM.

Of key interest for research is the controlled exposure experiment (CEE) approach in which cetaceans are intentionally exposed to a sound source (airguns in this case) and animal response/exposure level measured by attached digital-tags. This approach would lead to relatively precise estimates of behavioral changes in swimming, diving, and vocalizations correlated to measured received sound level. A debate remains on if these data are "worth" some degree of risk with intentional exposures.

Another approach BOEMRE and partners are pursuing is to actively monitor the existing situation in the GOM. All seismic vessels subject to BOEMRE permitting now provide observer reports as part of mitigation and monitoring requirements. These data can be integrated into an overall research evaluation of seismic effects. BOEMRE, through the Environmental Studies program, is working with a contractor to analyze data from the seismic observer reporting and a final report is expected in 2011. SWSS developed improved passive acoustic monitoring techniques — ultimately to predict the bearing and range of submerged sperm whales. This methodology can be transferred to mitigation detection applications and/or a research vessel can provide enhanced observations of ongoing seismic surveys. Improved satellite location tags with time depth recording (TDR) capacity -can provide diving depths and precise (GPS) surfacing locations over months to a year. A limited number of sperm whales could be tagged in advance of seismic operations and their movements correlated with vessel operations over extended times — in a sense, uncontrolled exposure experiments.

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