PETITION TO LIST THE GULF OF MEXICO DISTINCT POPULATION SEGMENT OF Sperm Whale (*Physeter macrocephalus*) UNDER THE U.S. ENDANGERED SPECIES ACT

Photograph: Encyclopedia of Life

Petition Submitted to the U.S. Secretary of Commerce, Acting through the National Oceanic and Atmospheric Administration and the National Marine Fisheries Service

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WILDEARTH GUARDIANS
A FORCE FOR NATURE

ABBREVIATIONS

BOEMRE – Bureau of Ocean Energy Management, Regulation, and Enforcement
CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora
DPS – Distinct Population Segment
EEZ – U.S. Exclusive Economic Zone
ESA – Endangered Species Act
FGBNMS – Flower Garden Banks National Marine Sanctuary
GulfCet – Gulf of Mexico Cetacean Study
IUCN – International Union for the Conservation of Nature
IWC – International Whaling Commission
MMPA – Marine Mammal Protection Act
MOM – Mouth of the Mississippi River
MPS – Mesoscale Population Study
NASA – National Aeronautics and Space Administration
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
OSP – Optimum Sustainable Population
PBR – Potential biological removal level
SEFSC – Southeast Fisheries Science Center
SWAMP – Sperm Whale Acoustic Monitoring Program
SWSS – Sperm Whale Seismic Study
USFWS – United States Fish and Wildlife Service

INTRODUCTION

WildEarth Guardians hereby petitions the Secretary of Commerce, acting through the NMFS,[1] to designate the sperm whale in the Gulf of Mexico as a "threatened" or "endangered" DPS under the ESA and designate appropriate critical habitat.

Sperm whales, *Physeter macrocephalus*, are currently globally listed as "endangered" under the ESA. Sperm whales as a group are endangered due to two and a half centuries of whaling, which was completely unregulated until 1970. The IWC prohibited member states from taking sperm whales beginning with the 1981-82 pelagic season and subsequently with the 1986 coastal season (NOAA 2010a at v). However, the Gulf of Mexico DPS deserves separate listing as it is a discrete population that is also significant to the species and faces additional unique threats to its survival.

PETITIONER

WildEarth Guardians is a nonprofit environmental advocacy organization that works to protect wildlife, wild places and wild waters. The organization has more than 12,000 members and supporters and maintains offices in New Mexico, Colorado and Arizona. WildEarth Guardians maintains an active endangered species protection program. As part of this program, Guardians

[1] NOAA Fisheries.

works to secure protection for a wide variety of imperiled wildlife and plants and the ecosystems on which they depend.

THE ENDANGERED SPECIES ACT AND IMPLEMENTING REGULATIONS

The Endangered Species Act of 1973 (ESA) protects plants and animals that are listed by the federal government as “endangered” or “threatened” (16 U.S.C. § 1531 et seq.). Any interested person may submit a written petition to the Secretary of Commerce requesting him to list a species as “endangered” or “threatened” under the ESA (50 C.F.R. § 424.14(a)). An “endangered species” is “any species that is in danger of extinction throughout all or a significant portion of its range” (16 U.S.C. § 1532(6)). A “threatened species” is defined as “any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range” (16 U.S.C § 1532(20)). “Species” includes subspecies and distinct population segments of sensitive taxa (16 U.S.C § 1532(16)).

The ESA sets forth listing factors under which a species can qualify for protection (16 U.S.C. § 1533(a)(1)):

A. The present or threatened destruction, modification, or curtailment of habitat or range;
B. Overutilization for commercial, recreational, scientific, or educational purposes;
C. Disease or predation;
D. The inadequacy of existing regulatory mechanisms; or
E. Other natural or manmade factors affecting its continued existence.

A taxon need only meet one of the listing criteria outlined in the ESA to qualify for federal listing.

If the Secretary determines that a species warrants a listing as “endangered” or “threatened” under the ESA, he is obligated to designate critical habitat for that species based on the best scientific data available (16 U.S.C. § 1533(b)(2)).

The NMFS and the USFWS have jointly published standards for defining a DPS (61 Fed. Reg. 4722). A species must be a vertebrate that is both discrete from other populations of the species and significant to the species as a whole. These terms are defined as follows:

> **Discreteness:** A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions:
>
> 1. It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.
> 2. It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act.

Significance: If a population segment is considered discrete under one or more of the above conditions, its biological and ecological significance will then be considered in light of Congressional guidance...that the authority to list DPSs be used‘‘...sparingly’’ while encouraging the conservation of genetic diversity. In carrying out this examination, the Services will consider available scientific evidence of the discrete population segment’s importance to the taxon to which it belongs. This consideration may include, but is not limited to, the following:

1. Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon,
2. Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon,
3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range, or
4. Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

Id. at 4725.

Although these criteria are “non-regulatory” and serve only as policy guidance for the agencies, NMFS is committed to using these criteria for evaluating DPSs described in this petition (Id. at 4723).

CLASSIFICATION AND NOMENCLATURE

Common Name. *Physeter macrocephalus* is known by the common name “sperm whale” and historically as the “common cachalot.” It is referred to as “sperm whale” in this petition.

Taxonomy. The petitioned species is the Gulf of Mexico DPS of *Physeter macrocephalus.* The full taxonomic classification is shown in Table 1. “There is a firm and long-standing scientific consensus that only one species of sperm whale exists. However, scientists have disputed the species’ nomenclature and systematics” (NOAA 2010a at I-3). A review of the nomenclature and systematics can be found in the Final Recovery Plan for the Sperm Whale (NOAA 2010a at I-3).

Table 1. Taxonomy of *Physeter macrocephalus*

Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Cetacea
Suborder	Odontoceti
Family	Physeteridae
Genus	*Physeter*
Species	*Physeter macrocephalus*
Distinct Population Segment	Gulf of Mexico DPS

SPECIES DESCRIPTION

"Male sperm whales can reach lengths of more than 18 meters (m), while females can reach lengths of up to 12.5 m. They can weigh up to 57 and 24 metric tons, respectively. The age distribution of the sperm whale population is unknown, but sperm whales are believed to live at least 60 years, with females potentially living up to 80 years. Sperm whale annual mortality rates are thought to vary by age" (NOAA 2010a at I-1, 2, internal citations omitted).

"Sperm whales have a disproportionately large head, one quarter to one third of their total body length. Their rod-shaped lower jaw is narrow and underslung, with 20–26 pairs of well-developed teeth in the mandibles, but the maxillary teeth are vestigial. Their eyes are relatively small. Sperm whales are generally dark gray in color, with white lips and often white areas on the belly and flanks. Their dorsal fin is low in profile, thick, and not pointed or curved, followed by knuckles along its spine… They have the largest brain of any animal on Earth, and their blunt snout houses a large reservoir of spermaceti, a high-quality oil" (NOAA 2010a at I-2, internal citations omitted).

Communication and hearing.

> The anatomy of the sperm whale ear indicates that it hears in the same functional acoustic division as bottlenose dolphins and appears tailored for ultrasonic (>20 kilohertz (kHz)) reception. The odontocete inner ear is primarily adapted for echolocation, and the ears have exceptional frequency discrimination abilities. The sperm whale may also possess better low frequency hearing than some of the other odontocetes, although not as low as many baleen whales. Southall *et al*. (2007) recently put sperm whales in the same hearing group (mid-frequency cetaceans), as "dolphins," toothed whales, beaked whales, and bottlenose whales (estimated hearing range 150 Hz to 160 kHz). The only data on the hearing range of sperm whales are evoked potentials from a stranded male neonate, which suggest that neonatal sperm whales respond to sounds from 2.5 to 60 kHz, with best sensitivity at 5, 10, and 20 kHz.
>
> Sperm whales produce several types of click sounds: patterned clicks (codas), usual clicks, creaks, and slow clicks. Codas are associated with social behavior and interactions within social groups. When sperm whales are socializing, they tend to repeat codas, which follow a precise rhythm and may last for hours. Codas are shared between individuals of a social unit and are considered to be primarily for intragroup communication. Usual clicks have interclick periods of 0.4 to 1 seconds and are heard most often when sperm whales engage in foraging/diving behavior. These may be echolocation clicks used in feeding, contact calls (communication), and orientation during dives. Creaks are a series of very rapid clicks and are thought to be produced by sperm whales as they are closing on a food item. Slow clicks have interclick periods greater than 5 seconds and are believed to be made only by adult males in the context of mating.
>
> Generally, most of the acoustic energy from sperm whales is present at frequencies

> below 4 kHz, although diffuse energy up to and past 20 kHz has been reported, with source levels up to 236 dB re 1 mPa-m. Other studies indicate sperm whales' wide-band clicks contain energy between 0.1 and 20 kHz. These have source levels estimated at 171 dB re 1 mPa. Current evidence suggests that the disproportionately large head of sperm whales is an adaptation to produce these vocalizations. This suggests that the production of these loud, low-frequency clicks, is extremely important to the survival of individual sperm whales… Long series of monotonous regularly spaced clicks are associated with feeding and are thought to be produced for echolocation.

(NOAA 2010a at I-2, 3, internal citations omitted)

Diet. "Most sperm whales are found in very deep waters (>3000m) but feed at 500–1000 m depths (where most of the food is found). As far as it is known, sperm whales feed regularly throughout the year. Lockyer (1981) estimated that they consumed about 3.0—3.5% of their body weight per day" (NOAA 2010a at I-9).

Sperm whales feed primarily on large- and medium-sized squid, but their prey also include other cephalopods, such as octopus, and medium-and large-sized demersal fish, such as rays, sharks, and many teleosts (NOAA 2010a at I-9).

Reproduction. Male sperm whales begin to mature at 7-13 years, but most do not become fully mature until 20+ years. Females usually begin ovulating at 7-13 years of age and usually conceive at about age 9. Gestation ranges from 15 months to more than a year and a half. Lactation lasts 2 years and the interval between births is 4-6 years. Females rarely conceive after age 40 (NOAA 2010a I-9).

Adult female sperm whales generally travel in groups with their sub-adult offspring. "Stable, long-term associations among related and unrelated females form the core units of sperm whale societies. Up to about a dozen females usually live in such groups, accompanied by their female and young male offspring. Males eventually leave these family groups after which they live in 'bachelor schools.' The cohesion among males within a bachelor school declines as the animals age, although bonding is evident as males have mass stranded. During their prime breeding period and old age, male sperm whales are essentially solitary" (NOAA 2010a I-9, 10, internal citations omitted).

In the winter, sexually mature males join the groups of females and subadults. "A male's association with a female group can be as brief as several hours. Since females within a group often come into estrus synchronously, the male need not remain with them for an entire season to achieve maximal breeding success" (NOAA 2010a at I-10).

Migration behavior. Most of the Gulf of Mexico population of sperm whales does not migrate (as discussed below). Other populations of sperm whales exhibit more extensive migration behavior. "A striking feature of the sperm whale's life history is the difference in migratory behavior between males and females. Typically adult males move in to the higher latitudes and all age classes and both sexes range throughout tropical and temperate seas" (NOAA 2010 at I-

6). “Although sperm whales are found throughout the world’s waters, it appears that only males penetrate to truly arctic waters, having been observed to move towards colder waters in the summer feeding seasons and return to warmer water to breed. Lyrholm and Gyllensten (1998) found that the dispersal of females was limited, suggesting the possibility of the development of genetic differentiation. However, Discovery Mark data from the days of commercial whaling (260 recoveries with location data) show extensive movements of both males and females from U.S. and Canadian coastal waters into the Gulf of Alaska and Bering Sea. While no firm boundaries can be drawn, there is likely very limited movement among the Atlantic, the Pacific, and the Indian Ocean. Moreover, the year-round presence of sperm whales in some areas (*e.g.*, northern Gulf of Mexico) suggests that there may be ‘resident’ populations in certain areas” (NMFS 2009 at 4, internal citations omitted).

Population growth rate. Sperm whale populations grow slowly. “Two particular aspects of the sperm whale’s reproductive biology are relevant to management. First, the maximal rate of increase in reproduction is very low, perhaps no more than one or two percent per year. Second, selective killing of large males by whalers could have had the residual effect of reducing reproductive rates” (NOAA 2010a at I-10, 11). Indeed, for the Northern Gulf of Mexico stock specifically, “the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive history” (NOAA 2010b at 200).

QUALIFICATION AS A DISTINCT POPULATION SEGMENT

NOAA concedes that “[e]xisting knowledge of the population structure of sperm whales is insufficient, and a more comprehensive understanding is essential for determining populations status and trends and developing strategies to promote recovery… It is possible that sperm whales could be more appropriately listed as DPSs, which would require an evaluation of discreteness and significance among populations" (NOAA 2010a at IV-7). We evaluate the qualifications of the Gulf of Mexico population of sperm whales as a distinct population segment below.

The Gulf of Mexico population’s physical and behavioral differences from other sperm whales, genetic differences based on mtDNA markers, and international boundaries and separate management qualify them as “discreet” under the DPS policy. The Gulf of Mexico population is also “significant” to the species as a whole because it occurs “in an ecological setting unusual or unique for the taxon” and its loss “would result in a significant gap in the range of [the] taxon.” As noted, it also “differs markedly from other populations of the species in its genetic characteristics,” which is also a qualification for “significance” (61 Fed. Reg. 4725).

DISCRETENESS. The Gulf of Mexico population is “markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors” (61 Fed. Reg. 4725). Various studies illustrate the differences in the Gulf whales. "Results of multi-disciplinary research conducted in the Gulf since 2000… indicate clearly that Gulf of Mexico sperm whales constitute a stock that is distinct from other Atlantic Ocean stocks(s)" (NOAA 2010b at 198), “stock” referring to “unit to conserve” (NOAA 2010a at I-3). Studies conducted by the SWSS support the NMFGS/NOAA conclusion. “Results of the SWSS, in particular the genetic analyses, movement patterns, photo-ID, coda vocalizations, and population structure support this stock conservation strategy. So far, none of the individuals photo-identified in the northern Gulf of Mexico have been matched to those in the North Atlantic and Mediterranean Sea Sperm Whale Catalogue (SWSS 2008 at 7, internal citations omitted).

Research on sperm whales in the Gulf of Mexico indicate genetic distinctness and describe a unique ecological setting for the species. If the whales in the Gulf of Mexico were extirpated, there is no evidence that other sperm whales would repopulate the same area.

Physical Differences

Genetic Differences. “In U.S. waters, the NOAA’s NMFS recognizes two MMPA stocks of sperm whales: a western North Atlantic stock and a northern Gulf of Mexico stock. Two recent PhD dissertations examined structure within the North Atlantic using genetic markers. Drout (2003) found mtDNA variation between samples collected in the Mediterranean Sea and the North Atlantic Ocean. Engelhaupt (2004) examined genetic variation among samples collected in the Gulf of Mexico, Mediterranean Sea, North Sea, and North Atlantic Ocean using mtDNA and nuclear genetic markers. Both studies found that all Mediterranean Sea samples were represented by a single mtDNA haplotype and Englehaupt (2004) found two unique haplotypes in the Gulf of Mexico. Both studies found significant genetic subdivision between isolated ocean basins (the Gulf of Mexico and the Mediterranean Sea) and the North Atlantic” (NOAA 2010a at I-7, internal citations omitted).

“SWSS mtDNA results show population structuring between northern Gulf of Mexico, western North Atlantic Ocean, North Atlantic Ocean, Mediterranean Sea, and North Sea putative populations was highly significant. The northern Gulf population structure supports the delineation of the northern Gulf into a female-dominated stock that is genetically distinct from those in other regions” (SWSS 2008 at 274).

Size. Research indicates that sperm whales in the Gulf are “1.5-2.0 m smaller on average compared to whales measured in other areas” (NOAA 2010b at 198). SWSS studies support these results. “The MPS cruises routinely used photogrammetric and passive acoustic methods to obtain size measurements of known individuals. Results indicate the north central Gulf sperm whales on average are smaller than those measured in any other sperm whale population, including those measured using exactly the same photogrammetric method in subtropical populations in the Gulf of California” (SWSS 2008 at 9, internal citations omitted). “[I]t is possible that the population studied is smaller because smaller animals may prefer the shallower waters relative to their diving ability and/or availability of suitable prey” (SWSS 2008 at 276).

Behavioral Differences

Group size. Sperm whales in the Gulf of Mexico group in smaller numbers than other sperm whales. “Female/immature group size in the Gulf is about one-third to one-fourth that found in the Pacific Ocean but more similar to group sizes in the Caribbean” (NOAA 2010b at 198). “Some groups of sperm whales in the Gulf were mixed-sex groups of females/immatures and others were groups of bachelor males. Typical group size for mixed groups was 10 individuals, which is smaller than group sizes in some other oceans" (SWSS 2008 at 9).

Migration Behavior. Sperm whales in the Gulf of Mexico differ from other populations in that they do not migrate. "Sperm whales are present year-round in the Gulf, with females generally having significant site fidelity and males and females exhibiting significant differences in habitat usage. The movements and home ranges of 52 sperm whales (33 females, 6 males, and 13 of undetermined sex) were studied using the S-tag data. Results show there are no discernable seasonal migrations, but there are basin-wide movements mainly along the slope of the northern Gulf" (SWSS 2008 at 7). "Additionally, there is apparent site-specific tenacity by many individuals, primarily females. Although the home ranges of some females tagged in the north central Gulf overlapped with some tagged in the northwestern Gulf, the core areas of females tagged in the two locations did not. This suggests the site-centric behavior observed in the north central and northwest Gulf females will likely be found in females from other areas of the Gulf. Females showed great affinity for the areas in which they were found, and hence tagged, in summer. Tagging occurred generally about the 1000-m isobath" (SWSS 2008 at 273).

Communication. The whales in the Gulf have a different repertoire of vocalizations than other sperm whales. "Sperm whales make vocalizations used in a social context called 'codas' that have distinct patterns that are apparently culturally transmitted, and based on degree of social affiliation, mixed groups of sperm whales… Recordings from mixed groups in the Gulf of Mexico compared to those from other areas of the Atlantic indicated that Gulf sperm whales constitute a distinct acoustic clan that is rarely encountered outside of the Gulf" (NOAA 2010b at 198-199).

> Analyses of coda vocalizations suggest there are significant differences in repertoires between the northern Gulf of Mexico population and the populations of the rest of the Atlantic. The acoustic recordings of coda vocalizations indicate that the mixed groups in the northern Gulf of Mexico belong to an acoustic clan that is rarely encountered in other areas and, from this, it is inferred that groups from other clans enter the northern Gulf of Mexico only infrequently. Results from the one SWSS cruise in the northwestern Gulf suggest there may be a different acoustic clan in the western Gulf and so far, none of the animals photo-identified in the core study area of the north central Gulf have been matched to photo-ID images from the northwest Gulf.

(SWSS 2008 at 7, internal citations omitted).

<u>International Boundaries and Management</u>

The Gulf of Mexico population is also partly delineated by international boundaries and different governmental management.

"The United States portion of the Gulf of Mexico region extends from the Florida Keys westward to the southern tip of Texas, following the coastline of five states. The combined coastline of these states totals over 47,000 miles (when including the shores of all barrier islands, wetlands, inland bays, and inland bodies of water). The Gulf of Mexico has an area of approximately 580,000 square miles, contains an approximate 584,000 cubic miles of water, and has an average depth of 5299 feet" (NOAA 2008b at 1, internal citations omitted). The EEZ generally extends 200 nautical miles (~230 miles) from the coastline, including within it the 1000m isobath and much of the seaward side of the isobath, and thereby covering much of the area inhabited by the Gulf of Mexico sperm whale population (*see* Figure 1, *also* Figure 2).

The requirements of the ESA apply differently within U.S. territorial waters than outside these areas. Within the EEZ, federal actions that might impact sperm whales are subject to Section 7 consultation requirements. This standard is set forth in section 16 U.S.C. §1536 (a)(2) of the Endangered Species Act:

> Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an "agency action") is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section. In fulfilling the requirements of this paragraph each agency shall use the best scientific and commercial data available.

Section 7 consultation is required for U.S. actions taken on the high seas (50 C.F.R. § 402.01), but is not currently required for federal actions carried out in foreign countries (50 C.F.R. § 402.01(a)). Section 9 prohibitions on "take" also apply differently within and outside of the EEZ. Section 9 prohibits those subject to U.S. jurisdiction from taking endangered species in the U.S., U.S. territorial seas, or upon the high seas (16 U.S.C. §§ 1538(a)(1)(B)-(C)). This prohibition does not extend to takings in foreign countries.

Lastly, the United States does not have the authority to designate critical habitat outside the U.S. (42 Fed. Reg. 4869; 43 Fed. Reg. 870).

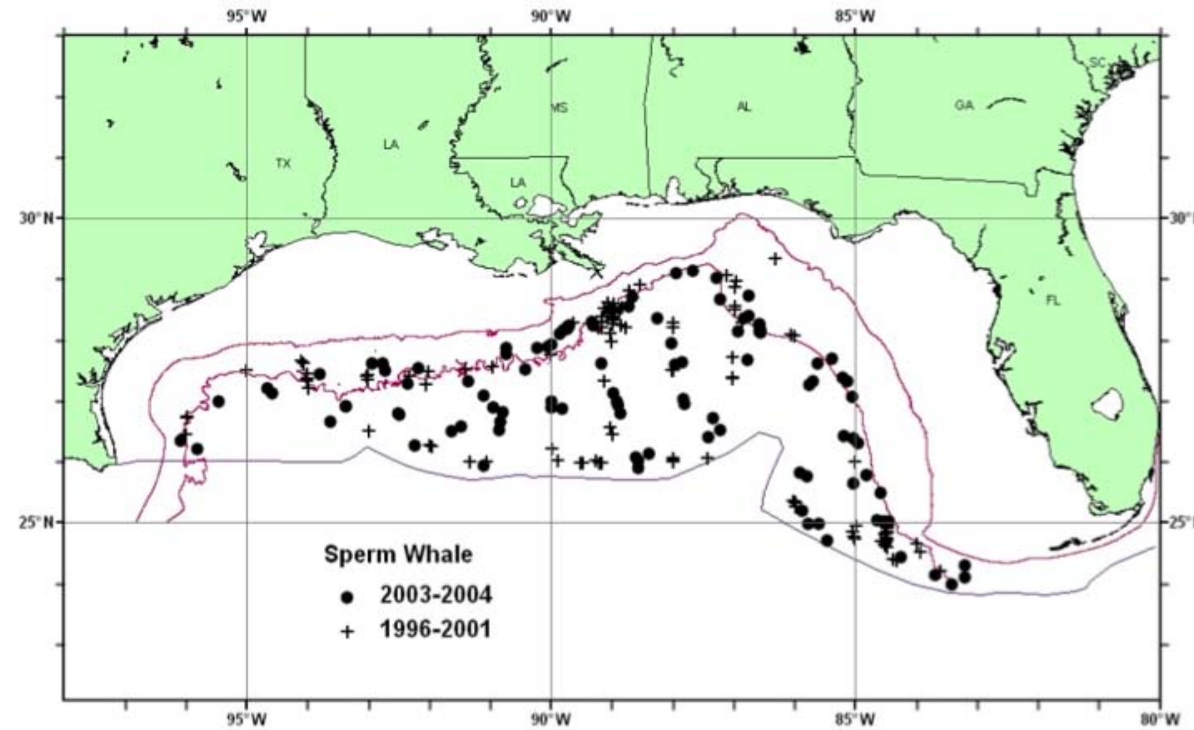

Figure 1. Distribution of sperm whale sightings within the EEZ from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. Solid lines indicate the 100 m and 1,000 m isobaths and the boundary of the EEZ. Source: NOAA 2010 at 1.

SIGNIFICANCE. The Gulf of Mexico population of sperm whales is significant to the species because protecting it would assure "persistence of the discrete population segment in an ecological setting unusual or unique for the taxon" (61 Fed. Reg. 4725). Sperm whales in the Gulf of Mexico have a unique range and are considered a resident, non-migratory population. This lack of migration behavior may, by itself, indicate the Gulf is a unique ecological setting for the species. The Gulf is a "semi-enclosed, intercontinental sea… As a large marine ecosystem, it has a unique bathymetry, hydrography and productivity" (Davis et al. 2000 at vii). The Gulf sperm whales, generally smaller than other sperm whales, may be specifically adapted to conditions in the Gulf. "[I]t is possible that the population studied is [physically] smaller because smaller animals may prefer the shallower waters relative to their diving ability and/or availability of suitable prey" (SWSS 2008 at 276). Sperm whales also contribute in important ways to the Gulf ecosystem. "Cetaceans, sea turtles and seabirds are upper trophic level predators that play an important role in the pelagic marine ecosystem of the Gulf of Mexico" (Davis et al. 2000 at vii).

Sperm whales worldwide "are often concentrated around oceanic islands in areas of upwelling, and along the outer continental shelf, continental slope, and mid-ocean waters." (NMFS 2009 at 11, internal citations omitted). "Sperm whales come close to shore in some areas where the continental shelf is close to shore, such as due to escarpments or canyons. For example, off Kaikoura, New Zealand, there is a year-round gathering of maturing males, with individual males staying there up to about 10 years… There are similar aggregations in other, at times even much more shallow, waters (e.g., off Long Island New York, in waters only 41-68 m deep)" (SWSS 2008 at 31-31, internal citations omitted).

The Gulf of Mexico is an area where sperm whales come relatively close to shore. For whales in the Gulf, "[t]agging occurred generally at about the 1000m isobath. Females tagged here rarely went into waters deeper than 2000 m. In contrast, other studies have shown females, including those with calves, are present in the deeper waters, suggesting there may be different distribution patterns for animals with possible depth preferences" (SWSS 2008 at 8, internal citations omitted). Satellite tags "indicate movements generally along the shelf break (700-1,000 m depth) throughout the Gulf, with some animals using deeper oceanic waters" (NMFS 2009 at 12). In the Gulf of Mexico, the 1,000 m isobath comes within 15-30 m of the coast in some places. Because of this, the Gulf population is found relatively close to shore, especially near the Mississippi Canyon area. "In the north-central Gulf of Mexico, sperm whales are especially common near the Mississippi Canyon, where they are present year-round" (NOAA 2010a at I-8). "Cetaceans in the northeastern and oceanic northern Gulf of Mexico were concentrated along the continental slope in or near cyclones and the confluence of cyclone-anticyclone eddy pairs… In the north-central Gulf, an additional factor affecting cetacean distribution may be the narrow continental shelf south of the Mississippi River delta. Low salinity, nutrient-rich water may occur over the continental slope near the MOM or be entrained within the confluence of a cyclone-anticyclone eddy pair and transported beyond the continental slope. This creates a deep-water environment with locally enhanced primary and secondary productivity and may explain the presence of a resident population of endangered sperm whales within 50 km [~31 miles] of the Mississippi River delta. We suggest that this area may be essential habitat for sperm whales in the northern Gulf" (Davis et al. 2000 at viii) (*see* Figure 2).

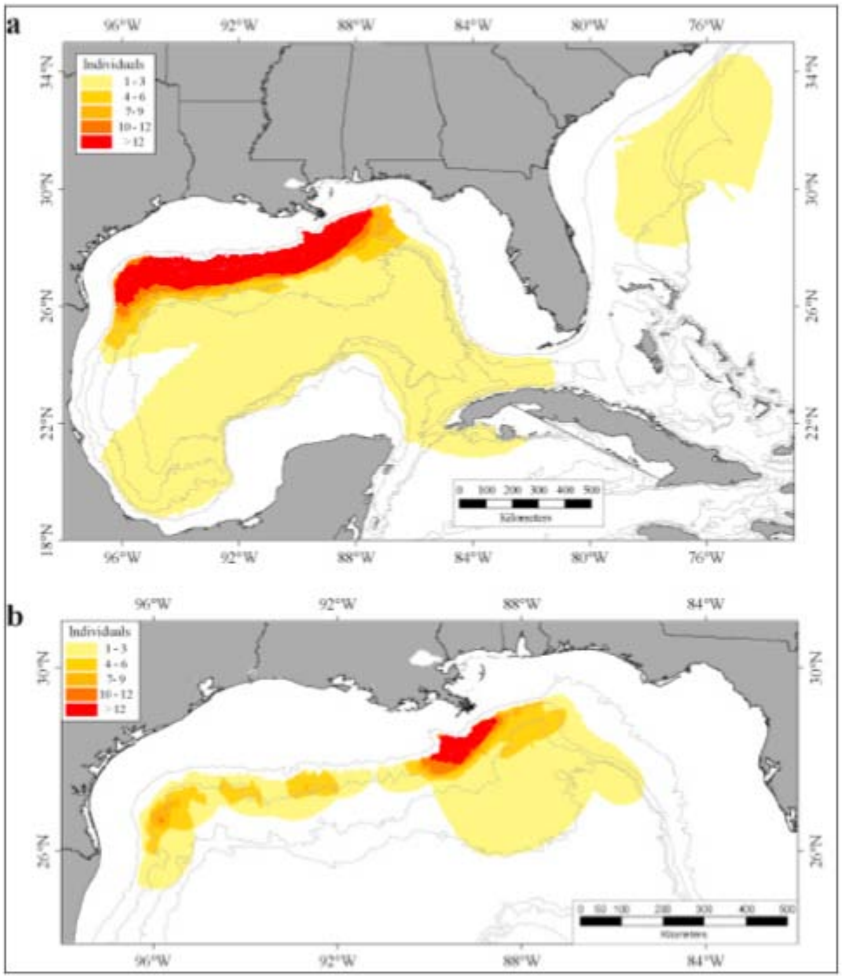

Figure 2. Home range (a) and core area (b) for satellite-tracked sperm whales in the Gulf of Mexico. Color contours indicate the number of whales that use the area. Line contours represent the 200, 1000, 2000, and 3000 m isobaths. Source: SWSS 2008 at 135.

Loss of the Gulf of Mexico population would result in a significant gap in the range of the taxon. “From genetic data largely derived during SWSS, Engelhaupt (2004) and Engelhaupt and Hoelzel showed that Gulf of Mexico sperm whales form an isolated or near-isolated population separate from the adjacent open waters of the North Atlantic. These data… rely almost exclusively on sperm whales from the northern Gulf, with greatest density along and deeper than the 1000 m depth contour, and do not adequately represent sperm whales that may occur regularly in the central, western, southern, or eastern Gulf. It is very likely, though, that sperm whales of the north-central Gulf, present there throughout the year, are more numerous than in other parts of the Gulf” (SWSS 2008 at 34, internal citations omitted). As it is generally only males that travel to and from the Gulf (see above), the loss of the female resident population would likely eliminate the breeding sperm whale population in the Gulf. There is no evidence suggesting that these genetically differentiated, linguistically unique, and physically smaller sperm whales would be replaced by whales from other areas if they were extirpated. “[A]nimals culturally adapted to feed or live in a particular way or place may not efficiently adapt to the need for rapidly making changes. This has been described in human societies, and may impact on cetaceans as well" (SWSS 2008 at 34, internal citations omitted).

Lastly, the discrete population of Gulf sperm whales differs from other populations in its genetic characteristics. "In general results tend to find low genetic differentiation among ocean basins and little evidence of subdivisions within ocean basins, with the exception of some distinct geographic basins such as the Mediterranean Sea and the Gulf of Mexico" (NOAA 2010a at IV-8). "Comparisons of mitochondrial DNA (mtDNA) and other molecular markers of tissue samples from sperm whales in the northern Gulf, Mediterranean Sea, North Sea, and North Atlantic Ocean reveal a significant genetic differentiation between the Gulf of Mexico population and populations in the other three regions" (SWSS 2008 at 7).

> Two recent PhD. dissertations examined structure within the North Atlantic using genetic markers. Drout (2003) found mtDNA variation between samples collected in the Mediterranean Sea and the North Atlantic Ocean. Engelhaupt (2004) examined genetic variations among samples collected in the Gulf of Mexico, Mediterranean Sea, North Sea, and North Atlantic Ocean using mtDNA and nuclear genetic markers… Both studies found significant genetic subdivision between isolated ocean basins (the Gulf of Mexico and the Mediterranean Sea) and the North Atlantic" (NOAA 2010a at I-7). "Engelhaupt *et al.* (2009) conducted an analysis of matrilineally inherited mtDNA and found a significant genetic differentiation between animals from the northern Gulf of Mexico compared to those from the western North Atlantic Ocean, North Sea and Mediterranean Sea. Analysis of biparentally inherited nuclear DNA showed no significant difference between whales sampled in the Gulf and those from the other areas of the North Atlantic, indicating that mature males move in and out of the Gulf.

(NOAA 2010b at 198).

The Gulf of Mexico population of sperm whales qualifies as a DPS under both the "discreteness" and "significance" requirements. Furthermore, this DPS faces unique threats not shared by the global population of sperm whales. It is inadequately protected by the ESA listing for the global population, as be described below. This DPS deserves separate listing as such under the ESA. Hereinafter, "species" or "sperm whale" should be understood to refer to the DPS described above.

RANGE AND HABITAT REQUIREMENTS

> The sperm whale is the most common large cetacean in the northern Gulf of Mexico, where it occurs in greatest density along and seaward of the 1000 m contour. They appear to prefer steep rather than shallow depth gradients. The spatial distribution of sperm whales within the Gulf of Mexico is strongly correlated with mesoscale physical features such as Loop Current eddies that locally increase primary production and prey availability. In the north-central Gulf of Mexico, sperm whales are especially common near the Mississippi Canyon, where they are present year-

> round, and their total range includes much of the wider Caribbean region… [S]atellite tags operated for over 12 months and indicate movements generally along the shelf break (700-1,000 m depth) throughout the Gulf, with some animals using deeper oceanic waters. Of 52 tagged animals, one male left the Gulf of Mexico but subsequently returned.

(NMFS 2009 at 12, internal citations omitted)

> SWSS results support the findings of GulfCet and SWAMP that led to the hypothesis that locally high chlorophyll features, particularly cyclonic eddies or eddy-induced off-margin flows, that persist for 3-4 months, provide sustained primary production that then can support the higher biological production that is important for the development of feeding grounds for sperm whales along the continental slope. Preliminary findings from comparisons of the locations of sperm whales observed during the 2005 S-tag cruise with the acoustic backscatter from a fishery echosounder that operated at frequencies chosen to achieve acoustic returns from nekton and micronekton, show that whales seem to go where the food is, as significantly higher backscatter was measured when whales were locally abundant. In summers 2002, 2003, and 2005, most sperm whales were encountered in regions of negative sea surface height anomaly and/or higher-than-average surface chlorophyll, as were the GulfCet and SWAMP animals. But this was not apparent every summer, for only a few of the whale encounters in summer 2004 were in regions of negative sea surface height anomaly and/or higher-than-average surface chlorophyll.

(SWSS 2008 at 280-281, internal citations omitted).

Core habitat for satellite-tracked sperm whales in the Gulf of Mexico appears to be within the 200 and 2000 m isobaths between 96ºW and 84ºW (*see* Figure 2).

POPULATION STATUS AND TRENDS

The sperm whale population, based primarily on transect surveys, are estimated at approximately 1349 sperm whales Gulf-wide, with a minimum abundance for the northern Gulf of 1114 individuals (SWSS 2008 at 8).

"Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor. The minimum population size is 1,409. The maximum productivity rate is 0.04, the default value for cetaceans. The 'recovery' factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP, is assumed to be 0.1 because the sperm whale is an endangered species. PBR for the northern Gulf of Mexico sperm whale is 2.8" (NOAA 2010b at 200, internal citations omitted). This means the long-term survival of the Gulf population is at risk if three or more whales are killed by human causes in addition to natural mortality.

"There are insufficient data to determine the population trends for this species. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate" (NOAA 2010b at 201). However, considering that the PBR is 2.8, it would not take a high level of mortality beyond the natural death rate to threaten the Gulf of Mexico population.

THE GULF OF MEXICO DPS OF SPERM WHALE FACES UNIQUE THREATS

Sperm whales in the Gulf of Mexico are at more risk than other sperm whales because they are a small, resident population that occurs in a particularly dangerous location. The population is threatened by oil and gas development, seismic exploration, noise pollution, effects from fishing, shipping traffic, and the recent BP Deepwater Horizon oil spill, among other factors. These whales are particularly at risk because they come relatively close to shore in the Gulf. A resident population is found "within 50 km [~31 miles] of the Mississippi River delta" (Davis et al. 2000 at viii). Whales this close to shore are especially vulnerable from development and ship traffic.

IDENTIFIED THREATS TO THE PETITIONED SPECIES: CRITERIA FOR LISTING

Sperm whales are globally listed as "endangered." However, listing the Gulf of Mexico population as a DPS is both warranted and necessary. At least three of the five ESA listing factors are contributing to the decline of sperm whales in the Gulf of Mexico (16 U.S.C. §1533(a)(1)) (in bold):

- **A. The present or threatened destruction, modification, or curtailment of habitat or range;**
- B. Overutilization for commercial, recreational, scientific, or educational purposes;
- C. Disease or predation;
- **D. The inadequacy of existing regulatory mechanisms; and**
- **E. Other natural or manmade factors affecting its continued existence.**

<u>(Factor A) The Present or Threatened Destruction, Modification, or Curtailment of the Species' Habitat or Range</u>

Oil and gas development. Marine mammals, including sperm whales, are affected by exposure to spilled oil, fumes, and dispersants. "These species do not have significant hair that can become oiled, but rely on a layer of fatty tissue for warmth. However, contact with oil can cause skin irritations, perhaps leading to infections. A more significant threat is inhalation of fumes when they surface to breathe. Moreover, their prey may be contaminated with hydrocarbons, or the prey populations may be reduced or absent... While marine mammals may be physically capable of avoiding oil slicks, according to the National Oceanic and Atmospheric Agency, '[r]esearch on dolphins in human care has shown that the animals avoid oil on the surface of the water, however observations of wild dolphins have documented the animals swimming in, feeding in and socializing in oiled water during previous oil spills in the Gulf of Mexico.'" (Corn and Copeland 2010 at 12-13, internal citations omitted). "Oil spills that occur while sperm whales are present could result in skin contact with the oil, ingestion of oil, respiratory distress from hydrocarbon vapors, contaminated food sources, and displacement from feeding areas. Actual impacts would depend on the extent and duration of contact, and the characteristics (age) of the oil. Most likely, the effects of oil would be irritation to the respiratory membranes and absorption of hydrocarbons into the bloodstream. If a marine mammal was present in the immediate area of fresh oil, it is possible that it could inhale enough vapors to affect its health. Inhalation of petroleum vapors can cause pneumonia in humans and animals due to large amounts of foreign material (vapors) entering the lungs… Long term ingestion of pollutants, including oil residues, could affect reproductive success, but data is lacking to determine how oil may fit into this scheme for sperm whales" (NOAA 2010a at I-39).

Gulf sperm whales are at heightened risk due to the Deepwater Horizon oil spill that began on April 20, 2010. NOAA concluded after the Deepwater Horizon oil spill that "the list of species that are likely to have direct mortality or indirect effects from loss of food, nesting habitat, and the like includes many fairly well-known species: piping plovers, least terns, five species of sea turtles, the American crocodile, three species of whales, manatees, and three species of sturgeon" (Corn and Copeland 2010 at 9). "In the early 1990s, the U.S. Marine Mammal Commission warned about oil and gas exploration in the Gulf. Considering the risk of a large oil spill to marine mammals, the commission said 'such effects might result in the complete loss of a regional population and require three or more generations to recover'" (Heenehan 2010 at 2).

"After the *Exxon Valdez* disaster, some populations of killer whales were reduced by as much as 40 percent, according to a 2008 study led by marine biologist Craig Matkin of the North Gulf Oceanic Society in Alaska. Even now, that killer whale population has yet to recover and will likely go extinct in a few decades, Matkin said. 'We lost so many females out of that group that they couldn't catch up again. They still haven't caught up,' he said. If the current oil spill causes more than three Gulf sperm whale deaths this year, it could push that group into the 'red zone'" (Than 2010 at 3). "Among social species, such as killer whales, loss of key individuals can affect large numbers of animals: when adult females in this matriarchal species died after the *Exxon Valdez* spill, the social disruption apparently led to suppressed reproduction, and likely to the later disintegration of a pod of whales" (Corn and Copeland 2010 at 22, internal citations omitted). "Risk factors for the sperm whales of the Gulf are similar to those for the killer whales of coastal Alaska: They are swimming in oil; females and juveniles depend on critical habitat near the spill, and the population is already small and isolated" (Heenehan 2010 at 2).

A sperm whale was found dead on June 15, 2010, 77 miles south of the Deepwater Horizon spill site (NOAA 2010c at 1). It was not possible to link the cause of death to the oil spill (Kaufman 2010 at 1, O'Hanlon 2010 at 1), but other whales may have died and gone undetected, as "[f]inding dead or affected whales [would] be difficult… because the animals spend most of their time underwater, and their bodies do not often wash ashore" (Than 2010 at 3). "NOAA and the Unified Command Wildlife Branch [received] numerous reports of sperm whales seen swimming in the oil, but this is the first confirmed report of a dead whale since the BP oil spill began. NOAA remains concerned about sperm whales... " (NOAA 2010c at 1). "Previous studies have shown that at least some of the Gulf of Mexico sperm whales are known to hang around where the Deepwater Horizon oil rig was located before it exploded... 'Between 2000 and 2005, about 300 [sperm] whales were seen on a consistent basis right in that area' [according to Celine Godard-Codding, an environmental toxicologist at Texas Tech University]" (Than 2010 at 2).

"Where a spill covers a very large area and volume of water as [the Deepwater Horizon spill] does in the Gulf, the animal may have to avoid much of its previous range" (Corn and Copeland 2010 at 13). Indeed, this appears to be occurring with Gulf sperm whales, as there is evidence that they have begun to avoid the area with the spill. "An acoustic site just nine miles from the spill and 1,000 meters (0.6 miles) down has nine years of data on local sperm whales. That, along with other acoustic archives of sperm whale calls from around the Gulf of Mexico and a rapid response grant from the National Science Foundation given to gather more acoustic data right after the spill, has allowed scientists to draw some preliminary conclusions about sperm whales' reactions to the spill. 'On the closest site, we see a pretty obvious trend that the number of whales did decrease,' said Natalia Sidorovskaia of the University of Louisiana at Lafayette… The good news is that at another listening site, 25 kilometers (15.5 miles) away, the average number of sperm whales appears to not have changed. The decrease in whales detected near the spill versus no change further away suggests the whales near the site left. Perhaps the presence of the oil, along with the noise of the Deepwater Horizon disaster, the emergency drilling and other ships coming and going spurred the sperm whales nearer the disaster site to hightail it for more comfortable, peaceful waters" (O'Hanlon 2010 at 1).

In addition to the Deepwater Horizon oil spill, whales in the Gulf of Mexico are constantly at threat from the potential for other oil spills. "Potential impacts from offshore oil and gas exploration and development include accidental spills, contamination by drilling, related effluents and discharge, anchoring of vessels involved in placing pipelines, drilling rigs and production platforms, seismic exploration, use of dispersants in oil spill mitigation and platform removal" (Waddell and Clark 2008 at 196). Twenty-seven percent of domestic crude oil production comes from the Gulf of Mexico region (NOAA 2008b at 2). "Eighty-three percent of the crude oil and 99% of the gas production in United States federal waters occurs in the Gulf of Mexico, primarily along the Texas-Louisiana continental shelf and slope. By 2003, oil production in the Gulf is projected to increase 43%. Production from deepwater fields (depth >305 m) will account for about 59% of the daily oil production and 27% of the daily gas production in the Gulf. In addition to oil and gas exploration and production, this area has considerable commercial shipping traffic that enters the northern Gulf ports. The long-term forecast for petroleum transportation is for the total volume to increase into the next century. The cumulative impact of these multiple, potential impact-producing factors on cetaceans in the northern Gulf cannot be predicted with certainty. However, it can be anticipated that cetaceans along the continental slope will encounter increasing oil and gas exploration and production activities. There are critical uncertainties in our understanding of short and long-term effects of seismic and other loud industrial sounds on the behavior and distribution of Gulf cetaceans. Against the background of growing oil and gas exploration and development, continued research and monitoring are needed to assess the potential impacts of these activities on pelagic cetaceans, sea turtles and seabirds in the Gulf of Mexico" (Davis et al. 2000 at ix-x).

Continued oil and gas development in the Gulf may particularly affect the "existence of a relatively small population of northern Gulf sperm whales with a rather limited home range that overlaps almost completely with areas of current and future oil related activity. It is clear that this population is living in close proximity to offshore oil and gas exploration and production and to all of the activities that come with this for many decades" (SWSS 2008 at 271).

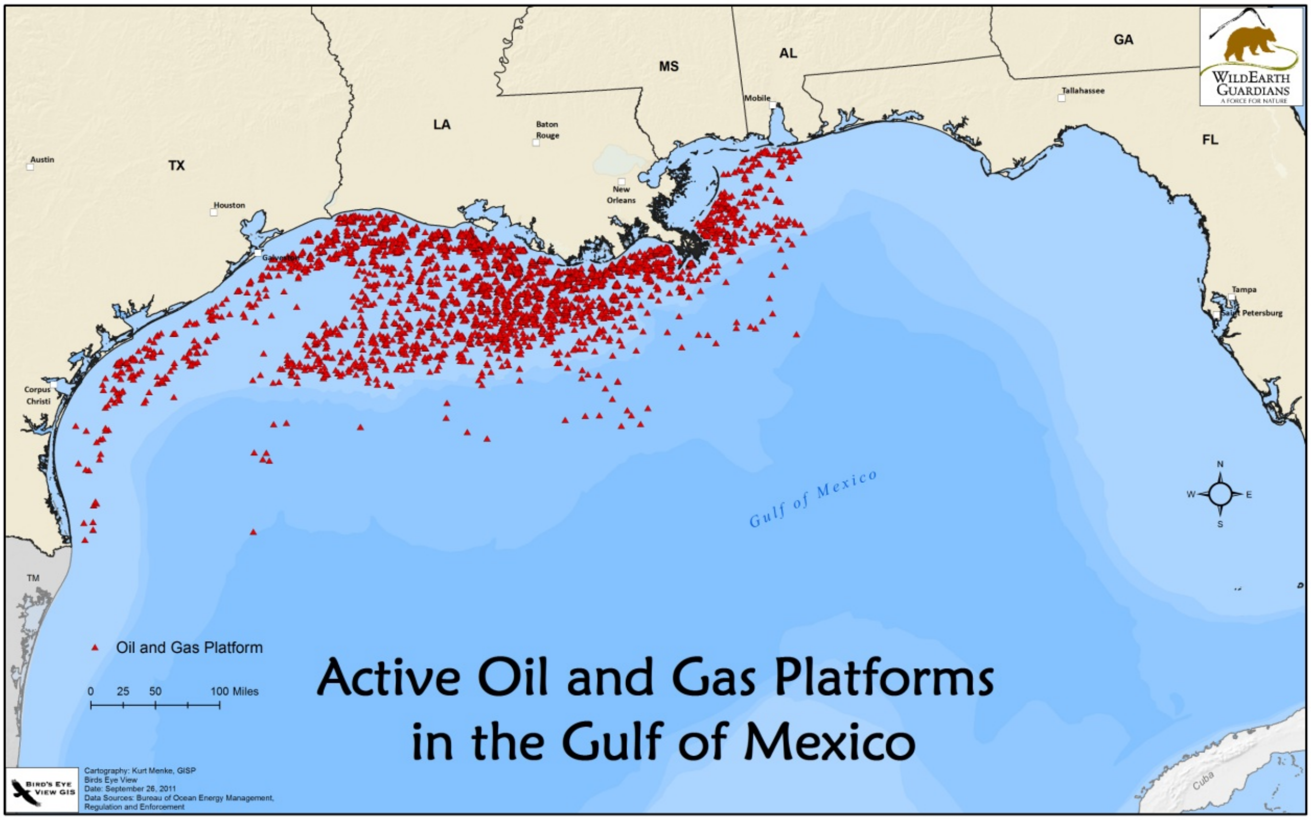

Figure 3. Active oil and gas platforms in the Gulf of Mexico (compare to Figure 2). There are approximately 4000 oil and gas platforms in the Gulf of Mexico (NOAA 2008b at 14). Data source: BOEMRE 2010. Map: Kurt Menke, Bird's Eye View GIS.

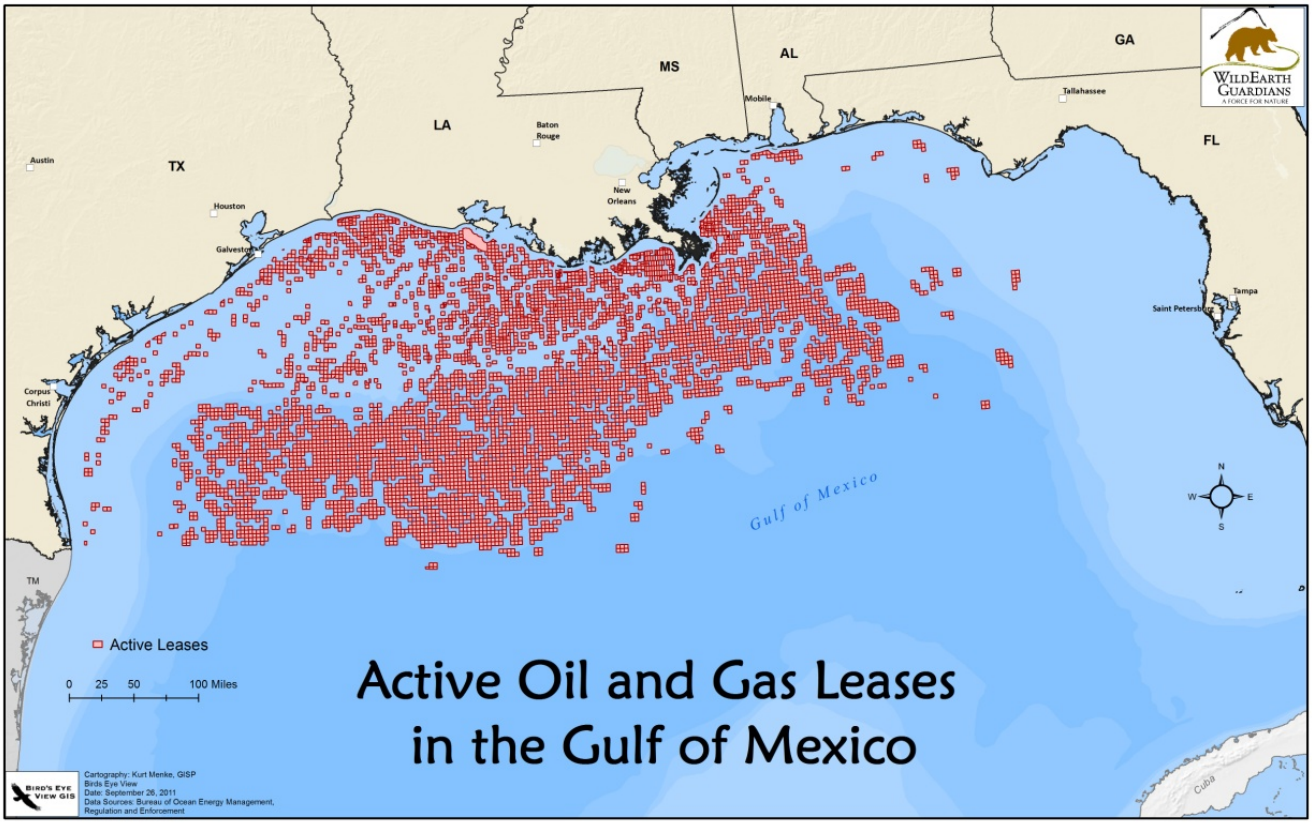

Figure 4. Active oil and gas leases in the Gulf of Mexico (compare to Figure 2).
Data source: BOEMRE 2011a. Map: Kurt Menke, Bird's Eye View GIS.

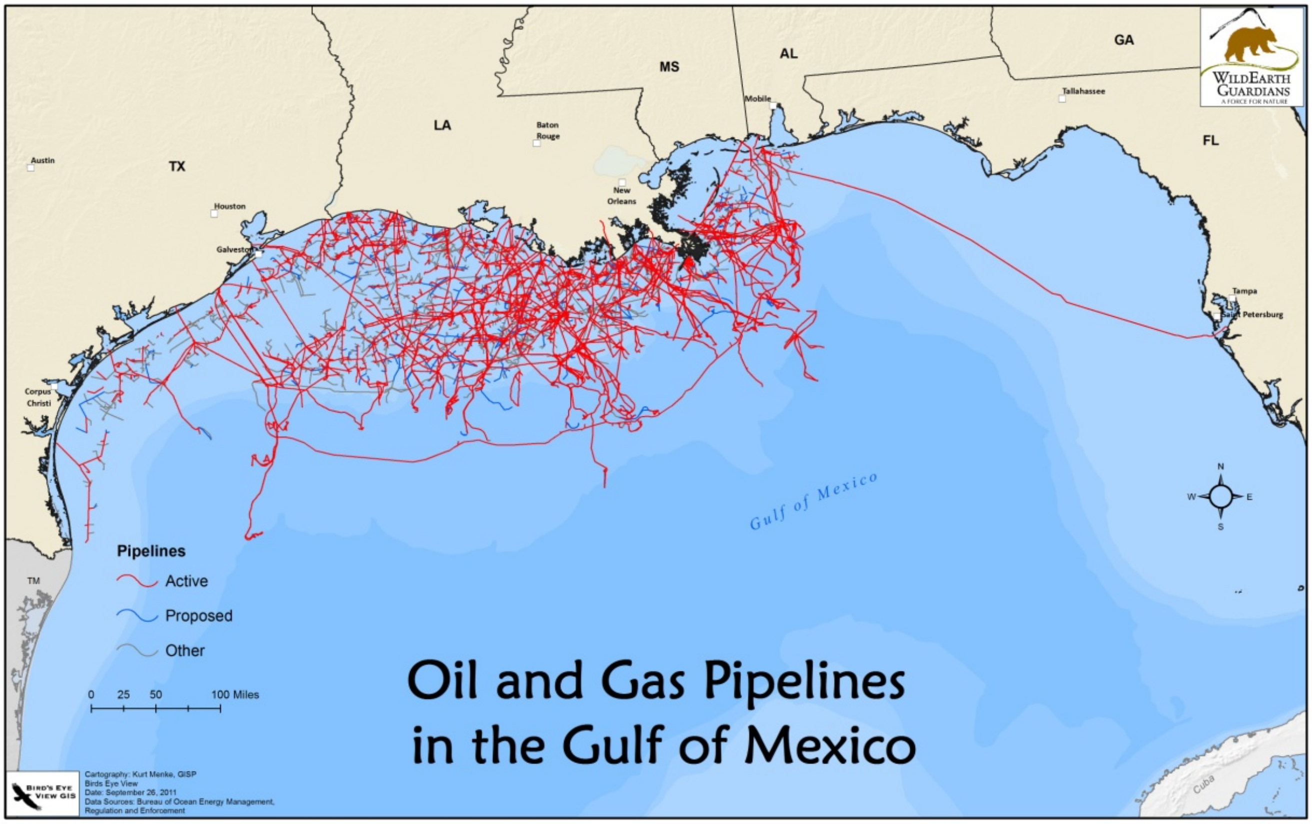

Figure 5. Oil and gas pipelines in the Gulf of Mexico (compare to Figure 2). There are approximately 25,000 miles of active oil and gas pipeline on the Gulf of Mexico sea floor. "If placed end to end, [they] could wrap around the Earth's equator" (NOAA 2008b at 14). Data source: BOEMRE 2011b. Map: Kurt Menke, Bird's Eye View GIS.

Destruction of coastal habitats. The broad-ranging problem of human modification and destruction of coastal habitats may effect the marine environment in the Gulf. The threat of rising human populations to coastal ecosystems is expected to increase: "As the global population continues to increase and demographic shifts toward coastal areas persist, even greater pressures will be placed on nearshore resources to satisfy human desires for food, culture, tourism, recreation and profit" (Waddell and Clarke 2008 at 8).

Coastal development may impact the Gulf through increased run-off with sediment and pollution into the Gulf and in the absence of the filtering/buffering effects of coastal wetlands. A recent report on the state of coral reef ecosystems reveal some of the impacts of coastal development on marine ecosystems in the Gulf of Mexico. The FGNBMS, in particular, may act as a barometer for the health of the Gulf ecosystem within the range of the sperm whale (*see* Figure 6). The FGBNMS is impacted by coastal runoff, which may be exacerbated by extreme weather events:

> The primary sources of degraded water quality include coastal runoff, river discharges and effluent discharges from off-shore activities such as oil and gas development and marine transportation. Oxygen-depleted (hypoxic) near-bottom waters have been found in a large

> area of the northern Gulf of Mexico. Often called the “dead zone” this area has included up to 16,500 km2 of the continental shelf from the Mississippi Delta to the Texas coast. Although relatively far from the [FGBNMS], there is concern that this area could continue to grow and impact outer continental shelf areas. General coastal runoff and degraded nearshore water quality can potentially impact the banks through cross-shelf transport processes which bring turbid, nutrient-rich water offshore. Deslarzes (2007) postulates the fluorescent bands observed in the carbonate skeletons of some corals come from the seasonal transport of nearshore water onto the FGBNMS, which may be tainted by urban, agricultural and biological contaminants. Research using nitrogen isotopes suggests a pathway for direct primary nitrogen input from coastal river sources from a considerable distance.

(Waddell and Clarke 2008 at 193, internal citations omitted)

> Hurricane Rita made landfall on the Texas-Louisiana border on September 24, 2005. The impact from the resultant rain and winds created a massive plume of discolored water originating from shore, and moving directly south. The plume reached the surface waters of the FGB by September 25. Unfortunately the composition of this discolored water was not determined, and it is unknown at this time whether the water mass reached the coral caps. The discolored water persisted for at least one month after the hurricane event.

(Waddell and Clarke 2008 at 193)

An increase in shipping and/or tourism in the Gulf may also affect sperm whale populations (*see* Factor E).

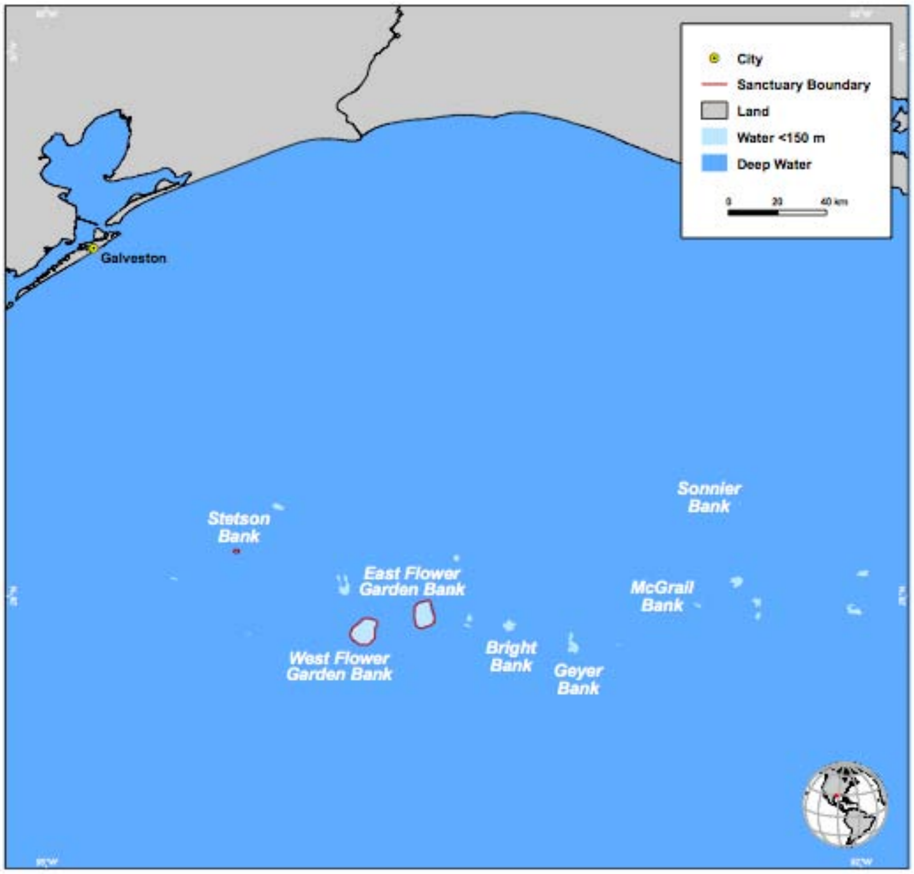

Figure 6. Locations of coral banks in the northwestern Gulf of Mexico.
Source: Waddell and Clark 2008 at 189.

Pollution/Dead Zone. “The potential impact, if any, of coastal pollution may be an issue for [the sperm whale] in portions of its habitat, though little is known on this to date” (NOAA 2010b at 201). A large section of the Gulf of Mexico is yearly rendered uninhabitable for marine life by agricultural run-off from the Mississippi. This resulting hypoxic area or “Dead Zone” continues to grow and poses threats to sperm whale habitat. A complete discussion of the Dead Zone is included under the same-titled subsection under Factor 5.

(Factor B) Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

No new information is available regarding the direct harvest of sperm whales. Although historical whaling activities were responsible for the depletion of sperm whales worldwide, they are now hunted only by Japan and in small numbers, and therefore, the threat of overutilization by direct harvest is currently low. However, if the International Whaling Commission’s (IWC's) moratorium on commercial whaling was ended, direct harvest could again become a threat to sperm whales. The IWC’s moratorium on commercial whaling for sperm whales throughout the North Atlantic and North Pacific has been in place for two decades. There is currently no legal commercial whaling for sperm whales in the Northern Hemisphere. Norway and Iceland have formally objected to the IWC ban on commercial

> whaling and are therefore under no obligation to refrain from hunting, but neither country has expressed interest in taking sperm whales. There is no evidence that whaling will resume in the Portuguese islands of the Azores and Madeira, even though Portugal remains outside any regulatory body. Canada has continued to ban whaling for the large baleen whales (except the bowhead, *Balaena mysticetus*) in its territorial waters under domestic regulations, and a resumption of sperm whaling in Canada is unlikely in the near future. Japan ceased hunting of sperm whales after the 1987 season, but currently takes a small number of sperm whales each year under an IWC exemption for scientific research.

(NMFS 2009 at 20)

(Factor C) Disease or predation

> …[O]nly two naturally occurring diseases that are likely to be lethal have been identified in sperm whales: myocardial infarction associated with coronary atherosclerosis, and gastric ulceration associated with nematode infection. The potential for parasitism to have a population level effect on sperm whales is largely unknown. Although parasites may have little effect on otherwise healthy animals, effects could become significant if combined with other stressors. Pollutants such as PCBs are known to suppress immune system function in some marine mammals, but there is considerable uncertainty in applying this knowledge to estimate how pollutants might increase disease susceptibility. Currently, there is no evidence of an increased level of disease in sperm whales, so the severity of this threat is considered to be low. However, given the potential but unknown effect of pollutants on immune suppression, the uncertainty in this determination is considered to be medium.

(NOAA 2010a at I-39, internal citations omitted).

(Factor D) Inadequacy of Existing Regulatory Mechanisms

Federal regulations. "In U.S. waters, sperm whales are currently protected under both the ESA and the MMPA… The sperm whale is also listed in Appendix I of [CITES]. The CITES clarification is intended to ensure that no commercial trade of sperm whale products occurs across international borders" (NOAA 2010a at I-51, internal citations omitted).

The listing of the global population of sperm whales as "endangered" and in Appendix I of CITES provides important protections for the Gulf of Mexico population. However, this may not be sufficient to ensure the survival of sperm whales in the Gulf, even if sperm whales in other oceans and ocean basins are thriving. If this population were listed as a DPS, Section 7 consultation requirements would then apply to actions that might threaten the continued existence specifically of the Gulf of Mexico DPS, not just the worldwide population of sperm whales (which could potentially survive without the Gulf DPS). Listing these whales as a DPS would also make them eligible for critical habitat designation separate from the global population. Once critical habitat is designated then Section 7 consultation requirements will help prevent further adverse modification of sperm whale habitat in the Gulf.

Federal regulations have failed to protect the Gulf from adverse affects of oil and gas development or catastrophic oil spills. The Department of the Interior's Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) is responsible for overseeing "the safe and environmentally responsible development of energy and mineral resources on the Outer Continental Shelf."[2]

NMFS is the Federal agency responsible for fisheries management in the United States' EEZ. Coastal states are responsible for inshore waters out to 3 miles of the coast (9 miles off the west coast of Florida and off Texas).[3] The EEZ is managed under the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006.[4] Federal and state law have failed to mitigate pollution run-off that causes the annual "Dead Zone" in the Gulf of Mexico, which continues to increase in size (see below).

State regulations. The sperm whale is not listed by the states of Texas[5] or Mississippi (MSNHP 2002) as a sensitive species. It is listed as "endangered" by the states of Florida (FWC 2011) and Louisiana.[6] Alabama does not appear to have a state list of threatened and endangered species.[7] State regulations will probably have little effect on the long-term survival of the Gulf of Mexico DPS of sperm whales, as the states have regulatory power over only a fraction of the Gulf. Texas and Florida maintain regulatory power over fisheries only as far as 9 miles off the coast, and Louisiana, Mississippi, and Alabama maintain regulatory power over fisheries only 3 miles off the coast.[8]

<u>(Factor E) Other Natural of Manmade Factors Affecting the Species' Continued Existence</u>

Fishery interactions. "The vulnerability of sperm whales to incidental capture in fishing gear, especially gillnets set in deep water for pelagic fish (*e.g.,* sharks, billfish, and tuna) and bottom-set longline gear, is well documented. Sperm whales may break through or carry away fishing gear. Whales carrying gear may die at a later time due to trailing fishing gear, become debilitated or seriously injured, or have normal functions impaired, but with no evidence of the incident recorded. Sperm whales may also become entangled while attempting to depredate… fish off fishing gear… Direct action taken by fishermen to protect their catch and gear from depredation by sperm whales could result in serious injuries or mortality" (NOAA 2010a at I-21, 22, internal citations omitted).

The threat to the Atlantic population of sperm whales from fishing is considered "low" (NOAA 2010a at I-22). "…In U.S. east-coast waters, bycatch of sperm whales has been documented in the pelagic drift gillnet fishery, which targeted primarily swordfish and tuna… There have been no recent interactions between sperm whales and commercial fishing gear in the Gulf of Mexico. It is possible that some mortality and injury occurs in offshore fisheries without being documented, such as that resulting from 'ghost fishing' by lost or discarded gear, but the level is

[2] www.boemre.gov/aboutBOEMRE/
[3] www.nmfs.noaa.gov/fishwatch/management.htm
[4] www.nmfs.noaa.gov/msa2007/
[5] www.tpwd.state.tx.us/huntwild/wild/species/endang/animals/mammals/
[6] www.wlf.louisiana.gov/wildlife/rare-animals-fact-sheets
[7] www.outdooralabama.com/watchable-wildlife/regulations/endangered.cfm
[8] www.nmfs.noaa.gov/fishwatch/management.htm

unknown" (NOAA 2010a at I-22, internal citations omitted). However, considering that the PBR for Gulf of Mexico sperm whales is 2.8, it would not take a high level of mortality from fishery interactions to affect the population as a whole.

Anthropogenic noise. The SWSS concluded "a possible threat to sperm whales is the increasing noise in the marine environment. The potential for noise from oil and gas industry operations, such as seismic surveys and vessel traffic, to damage marine mammal hearing and/or interfere with crucial vocal communications are valid reasons for concern" (SWSS undated at 8). "Humans have introduced sound intentionally and unintentionally into the marine environment for underwater communication, navigation, and research. Noise exposure can result in a multitude of impacts, ranging from those causing little or no impact to those being potentially severe, depending on level and on various other factors. Response to noise varies due to many factors, including type and characteristics of the noise source, distance between the source and the receptor, receptor characteristics (*e.g.*, sensitivity, behavioral context, age, sex, and previous experience with sound source) and time of the day or season. Noise may be intermittent or continuous, steady or impulsive, and may be generated by stationary or transient sources. As one of the potential stressors to marine mammal populations, noise may seriously disrupt marine mammal communication, navigational ability, and social patterns. Marine mammals use sound to communicate, navigate, locate prey, and sense their environment. Both anthropogenic and natural sounds may cause interference with these functions" (NOAA 2010a at I-25). "Sperm whales can be adversely affected by anthropogenic noise by permanently or temporarily damaging their hearing, masking the sounds animals would normally produce or hear, or instigating behavioral reactions to the noise that may lead to long- term effects on their survival or reproductive abilities" (NMFS 2009 at 16).

***Ship noise.* "**Surface shipping is the most widespread source of anthropogenic, low frequency (0 to 1,000 Hz) noise in the oceans. The National Resource Council (2003) estimated that the background ocean noise level at 100 Hz has been increasing by about 1.5 dB per decade since the advent of propeller-driven ships, and others have estimated that the increase in background ocean noise is as much as 3 dB per decade in the Pacific. Michel *et al.* (2001) suggest an association between long-term exposure to low frequency sounds from shipping and an increased incidence of marine mammal mortalities caused by collisions with ships" (NMFS 2009 at 16, internal citations omitted).

"Sound emitted from large vessels, particularly in the course of transit, is a principal source of noise in the ocean today, primarily due to the properties of sound emitted by cargo vessels. Ship propulsion and electricity generation engines, engine gearing, compressors, bilge and ballast pumps, as well as hydrodynamic flow surrounding a ship's hull and any hull protrusions and vessel speed contribute to a large vessels' noise emission into the marine environment. Prop-driven vessels also generate higher frequency noise through cavitations, which accounts for approximately 85% or more of the noise emitted by a large vessel. Larger vessels tend to generate lower frequency sounds and are louder" (NOAA 2010a at I-28, internal citations omitted).

“A recent preliminary analysis of acoustical data from the northern Gulf of Mexico also indicates that sperm whales are, in some cases, affected by the passing of vessels, with fewer clicks and fewer whales detected afterwards” (NOAA 2010a at I-36, internal citations omitted).

Oil and gas development noise. “[T]here may be statistically significant changes in the swimming and foraging behavior of sperm whales exposed to the sounds of airgun arrays in the exposure range of 111 to 147 dB re 1 μPa (rms) (131 to 164 dBp-p re 1 μPa) at distances of approximately 1.4-12.6 km from the sound source. The responses studied were selected for likelihood of biological significance, and are of particular interest given the small size of sperm whales in the northern Gulf. The acoustic measurements from D-tags demonstrate the necessity to measure exposure at the animal to detect critical responses – signals measured at the animal were very different from those predicted. The likelihood of an effect of seismic survey on foraging of sperm whales suggests the need for a larger sample of CEEs with longer exposure and control periods to increase the power of the test to detect effects. The discovery of a statistically significant 60% reduction in foraging for one whale coupled with evidence that other whales are less sensitive, emphasizes the need for statistical techniques to assess responses for each individual subject and for a broad coverage of age and sex classes of whales selected as subjects” (SWSS 2008 at 261, internal citations omitted).

Military sonar and explosives. “Military training activities by the U.S. Navy and the navies of other countries regularly occur in the Atlantic (including the Gulf of Mexico and Mediterranean Sea), Indian, and Pacific Oceans. These activities include anti-submarine warfare exercises, surface warfare exercises, anti-surface mine warfare exercises, missile exercises, sinking exercises, and aerial combat exercises. In addition to these training activities, the U.S. Navy conducts ship shock trials, which involve detonations of high explosive charges, and operates several permanent and temporary (portable) undersea warfare training ranges that employ acoustic sensors. These activities introduce a variety of sounds into the marine environment, but most studies have focused on the potential effects of active sonar, which has been associated with several marine mammal stranding events” (NOAA 2010a at I-31).

“For decades, sperm whales have been exposed to sounds associated with these training activities in waters off the Atlantic Coast (including portions of the Gulf of Mexico), off Southern California, in waters off the main Hawaiian Islands, the Mariana Islands, and off the coasts of Washington, Oregon, and Alaska. This pattern of exposure is likely to continue into the foreseeable future. What is largely unknown is how sperm whales respond to this type of exposure and what the consequences of that exposure could be on the longevity and reproductive success of sperm whales” (NOAA 2010a at I-32).

“Underwater detonations associated with military training activities range from large high explosives such as those associated sinking exercises or ship shock trials, to missile exercises, gunnery exercises, mine warfare, disposal of unexploded ordnance, and grenades. Detonations produce shock waves and sound fields of varying size. Animals that occur close to a large detonation might be killed or seriously injured; animals that are further away might suffer lesser injury (*i.e.*, tympanic membrane rupture, or slight to extensive lung injury); while animals that are even further away might experience physiological stress responses or behavioral disturbance whose severity depends on their distance from the detonation. The relatively large spatial scale, frequency, duration, and diverse nature of these training activities in areas in which sperm whales also occur suggests that these activities have the potential to adversely affect sperm whales. However, the severity of the effect of military sonar and detonations on sperm whales and the effectiveness of measures that avoid any adverse effects remains largely unknown and the uncertainty of our knowledge is high. Therefore, the relative impact to recovery of sperm whales due to this threat is ranked as unknown" (NOAA 2010a at I-34).

Ship strikes. The threat of ship strikes is likely elevated in the Gulf of Mexico, which contains "six of the top 10 leading shipping ports in the country" (NOAA 2008b at 2). "Ship strikes to whales occur world-wide and are a source of injury and mortality. One possible sperm whale mortality due to a vessel strike has been documented for the Gulf of Mexico. The incident occurred in 1990 in the vicinity of Grande Isle, Louisiana. Deep cuts on the dorsal surface of the whale indicated the ship strike was probably pre-mortem" (NOAA 2010b at 201, internal citation omitted).

"The possible impact of ship strikes on recovery of sperm whale populations is not well understood. Carcasses that do not drift ashore may go unreported, and those that do strand may show no obvious signs of having been struck by a ship. Because many ship strikes go unreported or undetected for various reasons and the offshore distribution of sperm whales may make ship strikes less detectable than for other species, the estimates of serious injury or mortality should be considered minimum estimates" (NOAA 2010a at I-36). Though the "relative impact of this threat to recovery… is not considered significant" (NOAA 2010a at I-36), this is considering the global population of sperm whales as a whole, not the smaller and more vulnerable DPS in the Gulf of Mexico. Considering that the PBR for Gulf of Mexico sperm whales is 2.8, it would not take a high level of mortality from ship strikes to affect the Gulf population.

Climate change. NMFS suggests that climate change could negatively affect the productivity of sperm whale populations.

> Although the effects of climate and oceanographic change on sperm whales are uncertain, they have the potential to greatly affect habitat and food availability. Site selection for whale migration, feeding, and breeding for sperm whales may be influenced by factors such as ocean currents and water temperature. Evidence suggests that the productivity in the North Pacific and other oceans is affected by changes in the environment. Increases in global temperatures are expected to have profound impacts on arctic and sub-arctic ecosystems and these impacts are projected to accelerate during this century. There is some evidence from Pacific equatorial waters that sperm whale feeding success and, in turn, calf production rates are negatively affected by increases in sea surface temperature. This could mean that global warming will reduce the productivity of at least some sperm whale populations. Any changes in these factors could render currently used habitat areas unsuitable. Further study is necessary to evaluate and understand the effects of changes to oceanographic conditions due to climate change on sperm whales and marine mammals in general.

(NMFS 2009 at 22, internal citations omitted)

Any effects of climate change on the global population of sperm whales will likely be magnified in the smaller, more isolated, and more narrow-ranging Gulf population.

Fisheries will likely also be impacted, affecting the whales' prey base:

> Increased variability in precipitation has the potential to greatly impact coastal fisheries by affecting freshwater inflow to estuaries, which in turn would affect flushing rates, the location of the freshwater-saltwater interface, and the quality of coastal estuarine nursery areas for fish and shellfish. Further inland, increased variability in precipitation has the potential to negatively impact riverine fish resources. Fishermen of the Terrebonne Fishermen's Organization expressed concerns about coastal erosion and the loss of coastal marsh habitat, which, in Louisiana, is mainly attributable to subsidence of deltaic deposits of the Mississippi River, and human alteration of coastal marsh… Marsh and other coastal habitats on which coastal fisheries depend play an important role as nursery grounds for many commercially important fish and shellfish species. Other commercially important fishes, whose life histories are not directly tied to coastal habitats, are dependent on fish and shellfish produced in coastal habitats. All aquatic organisms have particular ranges of physiological tolerance to factors like temperature, salinity, pH and dissolved oxygen. In general, species are found only in habitats that meet all of their requirements for survival, growth, and reproduction. These requirements often differ with different life history stages (eggs, larvae, and adults), particularly in marine and estuarine species. A change to warmer water temperature in the Gulf of Mexico, for example, has the potential to restrict the zone of inhabitance of temperate adapted species (northward movement in the Northern Gulf of Mexico is limited by the coastline) and shift the zone of more tropical adapted species northward. The same may be said for fishes in inland freshwater stream and lake habitats along the Gulf Coast. The species are generally temperature adapted, so any warming, or tendency toward warmer extremes than at present, has the potential to restrict their natural range. The ability of any of these species to migrate north or south is dependent on the range of stream sizes the species normally inhabits, and the presence of barriers to dispersal such as dams or natural physiographic features.

(Ning et al. 2003 at 24-25)

"Climate-induced changes in ocean temperatures might also alter circulation patterns in the Gulf of Mexico and Caribbean Sea. If so, South Florida could see changes in coastal and marine ecosystems, since it lies at a critical intersection of the Loop Current and the Gulf Stream. The interaction between these major circulation systems controls the distribution, recruitment, and survivability of coastal marine fish and invertebrate communities of the Florida Keys and other areas of South Florida. These currents also influence the residence time of water in nearshore environments and the transport of sediments and nutrients along the coast to Florida Bay" (Twilley et al. 2001 at 47). These are the same currents that support the sperm whale population. "The spatial distribution of sperm whales within the Gulf of Mexico is strongly correlated with mesoscale physical features such as Loop Current eddies that locally increase primary production and prey availability" (NMFS 2009 at 12).

The disruption of the Loop Current and other currents due to climate change would likely affect sperm whale prey availability and distribution patterns.

Some effects of climate change may already be visible in marine environments in the Gulf, as evidenced by recent bleaching events at the FGBNMS. "In 2005, elevated water temperatures were present on the reef cap for 50 days until September 23, 2005. By late August 2005, a bleaching event was underway at the [FGBNMS]. By October 2005, after the passage of two major hurricanes in the Gulf of Mexico, FGBNMS surveys reported that as much as 46% of the individual colonies exhibited some level of bleaching. Surveys conducted by FGBNMS in March 2006 showed that approximately 4-5% of the coral colonies still exhibited varying degrees of bleaching" (Waddell and Clarke 2008 at 191).

Biological vulnerability. Sperm whales reproduce at a very slow rate, having only one offspring at a time and nursing that offspring for multiple years. Their slow reproduction rate places the small population of sperm whales in the Gulf at a higher risk of extinction.

> Sperm whales are organized in groups in which adult females (some related and some not related to each other) travel with their sub-adult offspring. Males eventually leave these groups, after which they live in "bachelor schools." The cohesion among males within a bachelor school declines as the animals age, although bonding is evident by the fact that males mass strand. During their prime breeding period and old age, male sperm whales are essentially solitary. Maturation in males usually begins in this same age interval, but most individuals do not become fully mature until their twenties. Females usually begin ovulating at 7-13 years of age. Since females within a group often come into estrus synchronously, the male need not remain with them for an entire season to achieve maximal breeding success. In the northern hemisphere, the peak breeding season for sperm whales occurs between March/April and June, and in the southern hemisphere, the peak breeding season occurs between October and December. In both cases, some mating activity takes place earlier or later. The average calving interval in South Africa ranges from 5.2 (west coast) to 6.0-6.5 years (east coast). Clarke at al. (1980) proposed a 3-year reproductive cycle for the southeast Pacific. Gestation lasts well over a year, with credible estimates of the normal duration ranging from 15 months to more than a year and a half. Lactation lasts at least two years, and the inter-birth interval is 4-6 years for prime-aged females and, apparently, much longer for females over 40 years of age. Female sperm whales rarely become pregnant after the age of 40.

(NMFS 2009 at 5, internal citations omitted)

"Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor. The minimum population size is 1,409. The maximum productivity rate is 0.04, the default value for cetaceans. The 'recovery' factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP, is assumed to be 0.1 because the sperm whale is an endangered species. PBR for the northern Gulf of Mexico sperm whale is 2.8" (NOAA 2010b at 200, internal citations omitted). This means that the Gulf population's long-term survival is at risk if three or more whales are killed by human causes in addition to natural mortality.

Cultural disruption.

> When long-lived large-brained animals travel, feed, and socialize together, youngsters have the chance to learn from their mothers and other elders, and may then pass this information on to their offspring. This is the essence of culture, and it is now reasonably well established (one must be able to distinguish a learned behavior from a genetically transmitted one) that bottlenose dolphins (*Tursiops* sp.), humpback whales (*Megaptera novaeangliae*), killer whales (*Orcinus orca*), and sperm whales exhibit strong elements of culture. For sperm whales, culture may come in part through learned sequences of click sounds or codas shared among clans. These shared sound types may be a part of shared feeding habits, dive lengths, types of near-surface activities, or other behaviors. Some aspects of culture are not necessarily positive for animals in the face of human-caused (or other) environmental change. Much culture may have been erased due to wholesale whaling of cultural units, and animals culturally adapted to feed or live in a particular way or place may not efficiently adapt to the need for rapidly making changes. This has been described in human societies, and may impact on cetaceans as well. Culture can even get whales into trouble with humans, such as the learned behavior of killer and sperm whales to take salmon from long line fisheries off Alaska.

(SWSS 2008 at 34, internal citations omitted)

Pollutants/Dead Zone. Pollutants and an increasing "Dead Zone" pose a threat to sperm whales in the Gulf of Mexico. Since these whales are residents, they are exposed year-round to pollutants in the Gulf. The source of most of the pollution, and the resulting Dead Zone, is agricultural runoff from the Mississippi River basin. "Most studies indicate that fertilizers and runoff from human sources is one of the major stresses impacting coastal ecosystems" (NASA 2004 at 1). "The source of most of the nutrients in the dead zone is clear: fertilizer on Midwestern farms. Nine years ago, the federal government promised to find ways to reduce the flow of those nutrients. But for the past five years, the average nutrient load in the river has been higher than ever… Scientists trying to stem the dead zone say there is federal money to study solutions, such as planting cover crops in the winter to reduce runoff. But there's far more federal money in subsidizing traditional agriculture, and more money for the moment for cleaning up the oil in the Gulf" (Joyce 2010 at 2).

> The Mississippi River begins below Lake Itasca in northern Minnesota, and flows approximately 2,350 miles to the Gulf of Mexico. On this journey, the Mississippi River captures runoff from 41% of the continental United States, making it the largest watershed in North America. Human activities have greatly altered the Mississippi River and its watershed; as a result, the river delivers substantial amounts of sediment, nutrients, and chemical pollutants to the Gulf of Mexico. Since the 1970s, scientists have documented a large area of hypoxia off the coast of Louisiana and Texas. This "Dead Zone" forms

> annually in late spring, reaching its greatest extent in midsummer, and ebbing in the fall. Since 1985, it has fluctuated between 15 and 8,500 square miles in size, forming in the middle of a nationally important commercial and recreational fishing area.

(NOAA 2008b at 22)

> The majority of the land in Mississippi's watershed is farmland. Seventy percent of nutrient loads that cause hypoxia are a result of agricultural runoff caused by rain washing fertilizer off of the land and into streams and rivers. Additionally, 12 million people live in urban areas that border the Mississippi, and these areas constantly discharge treated sewage into rivers. The farm and urban discharge includes nutrients such as nitrogen and phosphorous that is very important for the growth of phytoplankton. About 1.7 million tons of these nutrients are delivered by rivers into the Gulf of Mexico every year. This huge influx of nutrients causes massive phytoplankton blooms to occur, this in turn leads to a large increase in zooplankton that feed on phytoplankton. Large amounts of dead phytoplankton and zooplankton waste then accumulate on the bottom of the seabed. The decomposition of this matter depletes the oxygen in the area faster than it can be replaced. This leads to large hypoxic areas called Dead Zones.

(NOAA 2009a at 1-2)

The dead zone in the Gulf of Mexico is rapidly increasing in size, posing a growing threat to the resident population of sperm whales. "Research indicates that the near tripling of nitrogen levels into the Gulf over the past 50 years from human activities has led to a dramatic increase in the size of the dead zone" (NOAA 2008a). "The hypoxic area in the Gulf of Mexico has more than doubled in size since the late 1980s" (NOAA 2009a at 1). "[2010's] dead zone is one of the biggest ever - the size of Massachusetts" (Joyce 2010 at 1), "stretching from the mouth of the Mississippi River, west to Galveston, Texas" (Joyce 2010 at 1). There are further concerns that the Deepwater Horizon oil spill could worsen the dead zone; "scientists have been concerned that oil in the Gulf could act the same way as nutrients: become food for microscopic animals" (Joyce 2010 at 1).

Pollution may affect the health of sperm whales in a variety of ways:

> A dramatic increase in the rate of sperm whale strandings in western Europe since the early 1980s has raised concern that anthropogenic effects, including pollution, may be a contributing factor. The results of a study that analyzed the tissues of some stranded whales for a wide range of contaminants showed no clear link between contamination and stranding. However, levels of mercury, cadmium, and certain organochlorines in these whales' tissues were high enough to cause concern about toxicity and other possibly indirect and less obvious effects. Fossi *et al.* (2003) stated that high concentrations in the Mediterranean could have an effect on reproductive rates of this species, warranting further study.
>
> Aguilar (1983) found that levels of organochlorine contaminants in sperm whales killed off northwestern Spain were intermediate between the levels found in fin whales (*Balaenoptera physalus*) and small odontocetes from the same region, most likely due to

> their diet of squid and benthic fish. Also, the levels of organochlorine compounds found in females were consistently higher than those in males, which is contrary to the typical findings in other marine mammals. Given that male and female sperm whales are geographically separated during much of the year, it is possible that males feed in less polluted waters or perhaps on less contaminated prey than females. Japanese scientists, Umezu *et al.* (1984), have investigated the hypothesis that sperm whales provide a medium for transporting radioactive cobalt (and other artificial radionuclides) from the deep seabed to surface waters. They showed that ^{60}Co bio-accumulates in sperm whales as they consume mesopelagic cephalopods, and this ^{60}Co is then dispersed as the sperm whales defecate at the surface, therefore generating an upward movement of ^{60}Co from the deep sea. Although it has been suggested that a high content of ^{60}Co may cause body burden to longer-living sperm whales, it is generally unknown whether ^{60}Co has any negative effects on the overall health of sperm whales.

(NMFS 2009 at 15-16, internal citations omitted)

Stranding. "Entire schools of sperm whales occasionally strand, but the causes of this phenomenon are uncertain. Although the causes of strandings of cetaceans in general are not well known, there is some evidence that sperm whale strandings may be linked to changes in wind patterns which result in colder and presumably nutrient-rich waters being driven closer to the surface. Lunar cycles, possibly as a result of the effects that light levels have on the vertical migration of their prey species, and solar cycles, possibly by creating variations in the Earth's magnetic field, may also play a role. However, the precise mechanisms are unclear" (NMFS 2009 at 6, internal citations omitted).

Cumulative threats. NMFS should consider whether the array of aforementioned threats intersect and act synergistically, therefore increasing the likelihood of endangerment of the Gulf of Mexico DPS of sperm whales. For example, even small numbers of mortalities from pollution, ship strikes, or fishery interactions, when compounded by the species slow rate of reproduction, may have deleterious effects on the entire DPS. Recovery from any reduction in population may be complicated by habitat loss and degradation due to oil and gas development, oil spills, and noise pollution. These are just examples of intersecting threats facing the sperm whale.

> Traits such as ecological specialization and low population density act synergistically to elevate extinction risk above that expected from their additive contributions, because rarity itself imparts higher risk and specialization reduces the capacity of a species to adapt to habitat loss by shifting range or changing diet. Similarly, interactions between environmental factors and intrinsic characteristics make large-bodied, long-generation and low-fecundity species particularly predisposed to anthropogenic threats given their lower replacement rates.

(Brook et al. 2008: 455, internal citations omitted).

> [O]nly by treating extinction as a synergistic process will predictions of risk for most species approximate reality, and conservation efforts therefore be effective. However challenging it is, policy to mitigate biodiversity loss must accept the need to manage

multiple threatening processes simultaneously over longer terms. Habitat preservation, restoring degraded landscapes, maintaining or creating connectivity, avoiding overharvest, reducing fire risk and cutting carbon emissions have to be planned in unison. Otherwise, conservation actions which only tackle individual threats risk becoming half-measures which end in failure, due to uncontrolled cascading effects.

(Brook et al. 2008 at 459, internal citations omitted).

REQUESTED DESIGNATION

WildEarth Guardians hereby petitions the Secretary of Commerce, acting through NMFS, to designate sperm whales in the Gulf of Mexico as a "threatened" or "endangered" DPS. Whales in the Gulf have distinct behavior and genetics and are a unique "resident" population that is significant to the species as a whole. They face unique threats including offshore oil and gas development, seismic exploration, noise pollution, fishery interactions, shipping traffic, and the recent BP Deepwater Horizon oil spill. We also request designation of critical habitat concurrent with listing to help ensure survival of the population.

REFERENCES

Brook, B.W., N. S. Sodhi, C. J. A. Bradshaw. 2008. Synergies among extinction drivers under global change. Trends in Ecology and Evolution 23: 453-460.

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). 2011a. Active Lease Polygons. Available at www.gomr.boemre.gov/homepg/pubinfo/repcat/arcinfo/index.html.

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). 2011b. Pipelines. Available at www.gomr.boemre.gov/homepg/pubinfo/repcat/arcinfo/index.html.

Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). 2010. Platforms. Available at www.gomr.boemre.gov/homepg/pubinfo/repcat/arcinfo/index.html.

Corn, M. Lynne and Claudia Copeland. 2010. The Deepwater Horizon Oil Spill: Coastal, Wetland and Wildlife Impacts and Response. Congressional Research Service. Available at www.fas.org/sgp/crs/misc/R41311.pdf.

Davis, R. W., W. E. Evans, and B. Wursig (eds.). 2000. Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume III: Data Appendix. Prepared by Texas A & M University at Galveston and the National Marine Fisheries Service. U.S. Department of the Interior, Geological Survey, Biological Resources Division and Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. Available at www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/3154.pdf.

Florida Fish and Wildlife Conservation Commission (FWC). 2011. Florida's Endangered and Threatened Species. Available at
www.google.com/url?sa=t&rct=j&q=florida%E2%80%99s%20endangered%20and%20threaten

ed%20species.%20%20&source=web&cd=2&ved=0CCUQFjAB&url=http%3A%2F%2Fmyfwc.com%2Fmedia%2F1515251%2FThreatened_Endangered_Species.pdf&ei=1bWgToH-HabmiAKC8IhT&usg=AFQjCNHdawLc3JKHH4OK8Ze-5dGoMP4h0A&cad=rja.

Heenehan, Heather. 2010. Oil threatens sperm whales in Gulf. CNN Opinion. Available at http://articles.cnn.com/2010-06-18/opinion/heenahan.oil.spill.whales_1_sperm-whales-killer-whales-oil-spill?_s=PM:OPINION.

Joyce, Christopher. 2010. "Massive 'Dead Zone' Threatens Gulf Marine Life" (radio report). National Public Radio, Morning Edition Transcript. Available at www.npr.org/templates/story/story.php?storyId=128946110.

Kaufman, Leslie. "Spill may have Taken its Largest Victim Yet." New York Times (June 18, 2010). Available at www.nytimes.com/2010/06/18/us/18whale.html.

Mississippi Natural Heritage Program (MSNHP). 2002. Endangered Species of Mississippi. Available online at www.google.com/url?sa=t&rct=j&q=mississippi%20state%20endangered%20species%20list&source=web&cd=6&sqi=2&ved=0CFMQFjAF&url=http%3A%2F%2Fwww.mdwfp.com%2Fmuseum%2Fdownloads%2Ftandelist.pdf&ei=tLOgTpeKNYLliALiucFt&usg=AFQjCNHBVTt0pMrGmaOO1wkMV_fu7qUR-g.

National Aeronautics and Space Administration (NASA). 2004. Mississippi Dead Zone. Available at www.nasa.gov/vision/earth/environment/dead_zone.html.

National Marine Fisheries Service (NMFS). 2009. Sperm Whale *(Physeter macrocephalus)* 5-Year Review: Summary and Evaluation. National Marine Fisheries Service, Office of Protected Resources. Silver Spring, MD. Available at www.nmfs.noaa.gov/pr/pdfs/species/spermwhale_5yearreview.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2010a. Final Recovery Plan for the Sperm Whale *(Physeter macrocephalus)*. National Marine Fisheries Service, Office of Protected Resources. Silver Spring, MD. Available at www.nmfs.noaa.gov/pr/pdfs/recovery/final_sperm_whale_recovery_plan_21dec.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2010b. Sperm Whale (*Physeter macrocephalus*): Northern Gulf of Mexico Stock. National Marine Fisheries Service, Office of Protected Resources. Silver Spring, MD. Available at www.nmfs.noaa.gov/pr/pdfs/sars/ao2010whsp-gmxn.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2010c. "NOAA Conducts Tests to Determine Fate of Whale Found Dead in Gulf of Mexico" (press release) (June 17, 2010). Available at www.noaanews.noaa.gov/stories2010/20100617_whale.html.

National Oceanic and Atmospheric Administration (NOAA). 2009a. “NOAA Knows... Dead Zones. Hypoxia in the Gulf of Mexico” (factsheet). Available at www.noaa.gov/factsheets/new%20version/dead_zones.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2009b. Sperm Whale (*Physeter macrocephalus*): Northern Gulf of Mexico Stock. National Marine Fisheries Service, Office of Protected Resources. Silver Spring, MD. Available at www.nmfs.noaa.gov/pr/pdfs/sars/ao2009whsp-gmxn.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2008a. “NOAA and Louisiana Scientists Predict Largest Gulf of Mexico ‘Dead Zone’ on Record this Summer” (news release). Available at www.noaanews.noaa.gov/stories2008/20080715_deadzone.html.

National Oceanic and Atmospheric Administration (NOAA). 2008b. The Gulf of Mexico at a Glance. A Tool for the Gulf of Mexico Alliance and the American Public. Available at http://gulfofmexicoalliance.org/pdfs/gulf_glance_1008.pdf.

Ning, Zhu H., R. Eugene Turner, Thomas Doyle, and Kamran Abdollahi. 2003. Preparing for a Changing Climate. The Potential Consequences of Climate Variability and Change - Gulf Coast Region. Findings of the Gulf Coast Regional Assessment.

O’Hanlon, Larry. 2010. Sperm Whales Cleared Out After Gulf Oil Spill. Discovery News. Available at http://news.discovery.com/animals/sperm-whales-gulf-oil-spill.html.

Sperm Whale Seismic Study (SWSS). Undated. Gulf of Mexico - Home to Whales and Dolphins. Sponsored by the U.S. Minerals Management Service. Available at http://seawater.tamu.edu/swss/doc/Cetacean.pdf.

Sperm Whale Seismic Study (SWSS). 2008. Sperm Whale Seismic Study in the Gulf of Mexico. Synthesis Report. Available at http://seawater.tamu.edu/swss/doc/2008-006.pdf.

Than, Ker. 2010. Oil Spill to Wipe Out Gulf's Sperm Whales? National Geographic Daily News. Available at http://news.nationalgeographic.com/news/2010/05/100521-science-environment-gulf-mexico-oil-spill-sperm-whales/.

Twilley, R. R., E. J. Barron, H. L. Gholz, M. A. Harwell, R. L. Miller, D. J. Reed, J. B. Rose, E. H. Siemann, R. G. Wetzel, and R. J. Zimmerman. 2001. Confronting Climate Change in the Gulf Coast Region: Prospects for Sustaining Our Ecological Heritage. Union of Concerned Scientists, Cambridge, MA; Ecological Society of America, Washington, D.C.

Waddell, J. E. and A. M. Clarke (eds.). 2008. The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2008. NOAA Technical Memorandum NOS NCCOS 73. NOAA/NCCOS Center for Coastal Monitoring and Assessment’s Biogeography Team. Silver Spring, MD. Available at http://ccma.nos.noaa.gov/stateofthereefs.