A report on designating critical habitat for the Gulf of Mexico Bryde's whale (*Balaenoptera edeni*) under the Endangered Species Act

Photo credit: NOAA

April 6, 2020

Submitted by the Natural Resources Defense Council (NRDC)

On April 15, 2019, the National Marine Fisheries Service (NMFS) published a final regulation, pursuant to section 4(b)(6)(A) of the Endangered Species Act, listing the Gulf of Mexico Bryde's whale as an endangered species (NOAA 2019). NMFS declined to designate critical habitat in the same rulemaking on the grounds that it was not then "determinable," while noting that the agency was currently evaluating habitat within and outside the areas occupied by the species for potential designation. Under these circumstances, the statute allows NMFS one additional year to publish a final rule designating critical habitat, to the maximum extent prudent, based on the best available scientific data (ESA section 5(b)(6)(C)(ii)).

Our understanding is that NMFS does not intend to publish a final regulation by this deadline. To aid NMFS in fulfilling its responsibility under the Act, we submit this report, which summarizes and synthesizes the best available data on the population's habitat use in the Gulf of Mexico.

The report was prepared by Joe Roman (Gund Institute for Environment, University of Vermont). The critical habitat map was compiled by Francine Kershaw (NRDC), and Michael Jasny (NRDC) and Francine Kershaw provided consultation and review.

1. Introduction

The Gulf of Mexico Bryde's whale, or Gulf of Mexico whale,[1] was listed as endangered under the Endangered Species Act on April 15, 2019 (NOAA 2019a). It is one of the rarest whales on Earth, with an estimated population size of 26 to 44 individuals. The greatest threats to Gulf of Mexico whales include habitat destruction, modification or curtailment of habitat range during energy exploration and development, oil spills, vessel collisions, and anthropogenic noise (Rosel et al. 2016). Fishery interactions may also pose a threat. The Gulf of Mexico whale's limited distribution and small population size, along with associated risks such as demographic stochasticity, genetics, and stochastic and catastrophic events, increase its vulnerability.

Prior to a status review conducted by NOAA, which followed a petition by the Natural Resources Defense Council, little information or synthesis was available on the current distribution and abundance of the Gulf of Mexico whale and the risks it faces today. In the past ten years, the species' taxonomic status, small population size, and existential vulnerability have become clearer.

In 2010, the *Deepwater Horizon* spill exposed the vulnerability of this small population to catastrophic events. The Gulf of Mexico whale was the offshore cetacean most affected by the spill (Rosel et al. 2016). Approximately 48% of its known habitat was oiled, and the spill is estimated to have killed 17% of the population (DWH MMIQT 2015). Several years later, genetic analysis revealed that Bryde's whales in the Gulf of Mexico are significantly different from all other Bryde's whales, a divergence that is likely on a subspecies or even species level (Rosel and Wilcox 2014, Rosel et al. 2016). Population estimates for the Gulf of Mexico whale currently range from 26 individuals, based on visual survey data conducted after the *Deepwater Horizon* spill (DWH NRDA Trustees 2016); to 33 individuals, from transect surveys conducted in 2009 (Garrison 2016); to a model-based estimate of 44, which includes corrections for animals unavailable for sighting (Roberts et al. 2016). The current population trend is considered to be decreasing (Corkeron et al. 2017).

This report reviews our current understanding of the habitat used by the Gulf of Mexico whale, at present and in the past, and considers the habitat that will be necessary for future recovery. It describes the importance of critical habitat for the species, relying on the best available science. The designation of critical habitat assists federal agencies in planning future actions by establishing areas that will be given special consideration in section 7 consultations under the ESA. The designation allows potential conflicts between development and listed species to be identified and avoided early in the planning process. (58 Fed. Reg. 29186, 29187 (May 19, 1983).) Prompt designation of critical habitat for the Gulf of Mexico whale is an essential step in protecting this high-risk population.

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[1] In this report, we follow the terminology of *The IUCN Red List of Threatened Species* for the common name, Gulf of Mexico whale. We believe this designation accurately reflects the unique character of this taxon, which, given its evolutionary distinctiveness, represents a unique species or subspecies.

2. Areas Proposed for Designation

Under section 3(5)(A), the Endangered Species Act identifies two components of critical habitat: (1) It comprises specific areas within the geographical area occupied by the species at the time it is listed, on which are found physical or biological features that are essential to the conservation of the species and may require special management considerations or protection; and (2) it includes specific areas outside the geographical area occupied by the species at the time it is listed, if such areas are determined to be essential for the conservation of the species (16 U.S.C. 1532(5)(A)).

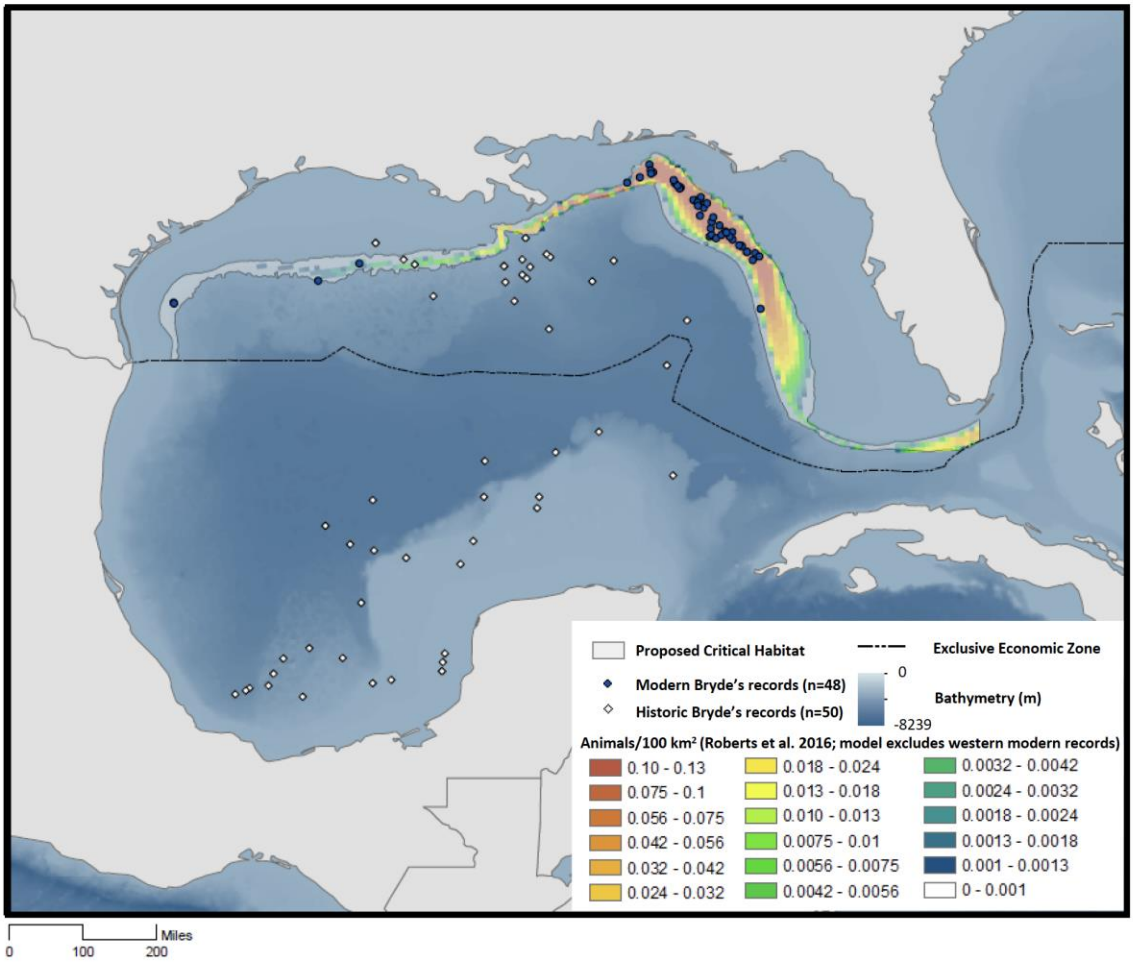

Figure 1. Proposed Critical Habitat for the Gulf of Mexico whale, defined by the area between the 100-m and 500-m isobaths. Contemporary (1992-2018) sightings are shown as blue circles (n=48), historical records (1791-1876) as white diamonds (n=50). Number of animals per 100 km^2 based on the habitat density model developed by Roberts et al. (2016) is also shown. Note that the Roberts et al. (2016) model does not include 26 of the 48 contemporary sightings recorded on the map, including the four westernmost sightings. See Appendix 1 for an alternative model that includes additional sightings data (Roberts et al. 2015).

In this petition, we propose the protection of core habitat, where the whales are most commonly observed, and an area outside the core habitat that is essential to their survival and recovery. These combined areas extend from 81° 53'W off southern Florida westward to the Mexican Exclusive Economic Zone, between the 100-m and 500-m isobaths. They are represented in Fig. 1.

(a) *Core habitat*

The Gulf of Mexico is a semi-enclosed, intercontinental sea with a total area of about 1.5 million km^2 (Davis et al. 2002). The entire known range of the Gulf of Mexico Bryde's whale occurs in this sea, with De Soto Canyon in the northeast Gulf forming the core—although not the entirety—of the species' range. The reasons for the small population size and restricted distribution are unknown, but high levels of industrial activity in the Gulf of Mexico could be a significant factor (Soldevilla et al. 2017). It is also likely that the presence of prey and relatively low level of noise near the canyon make it an attractive area for this population. In 2015, LaBrecque et al. defined a biologically important area (BIA) of 23,559 km^2 for this small, resident population (Fig. 2). The study was based on observations of whales between the 100-m and 300-m isobaths from south of Pensacola, Florida, at the head of DeSoto Canyon, to northwest of Tampa Bay. The BIA was developed as part of the National Marine Fishery Service's CetMap project, which relies on quantitative density and distribution mapping and expert consultation.

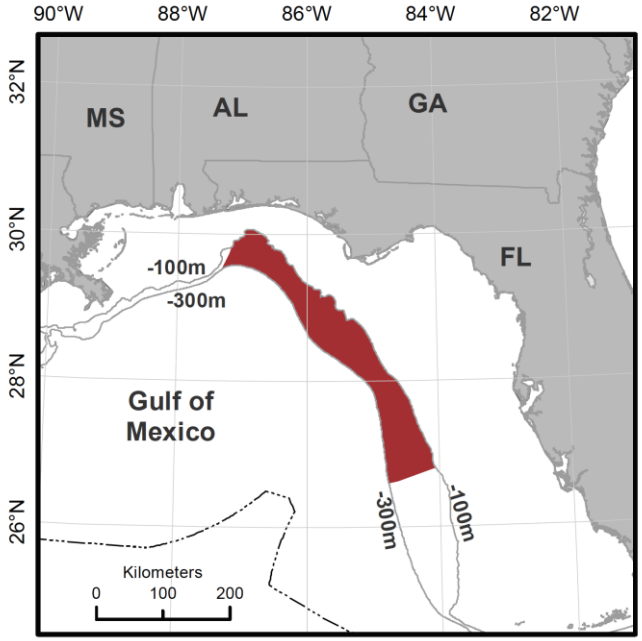

Figure 2. The Biologically Important Area for the Gulf of Mexico whale, as defined by LaBrecque et al. (2015).

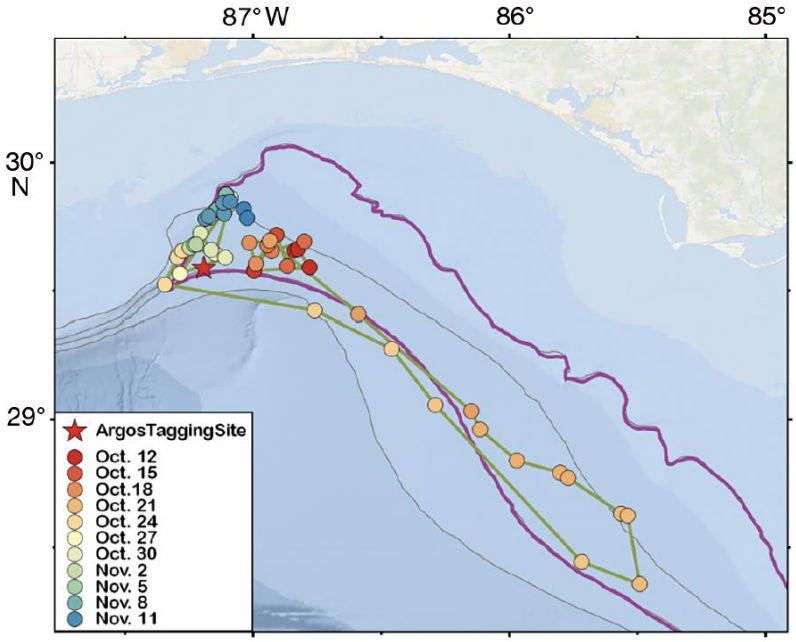

Figure 3. Track of satellite-tagged Gulf of Mexico whale from October 11 to November 12, 2010. During the 33 days of tracking, the whale crossed or traveled to the edges of both the 100-m and 400-m isobaths (100-, 200-, 300-, and 400-m isobaths are shown). From Soldevilla et al. 2017.

Yet questions remain about the current and former distribution of Bryde's whales within the northern Gulf of Mexico (Rosel et al. 2016). As noted by the Status Review Team, which was formed to consider the federal listing of the Gulf of Mexico whale under the ESA, the BIA does not fully capture the extent of important habitat either within De Soto Canyon or beyond it (Rosel et al. 2016). In particular, Gulf of Mexico whale sightings have occurred outside of the original 100-m to 300-m isobath. The status review team noted: "[T]he BIA area is probably better defined out to the 400 m depth contour and to Mobile Bay, Ala., to provide some buffer around the deeper water sightings and to include all sighting locations in the northeastern GOMx."

Indeed, since the publication of the Status Review, there have been several additional observations that extend the known range of the Gulf of Mexico whale. Support for the extension of the isobath from 300 m to 500 m includes shipboard sightings (302 m and 309 m, Rosel et al. 2016), satellite-tag locations (Fig. 3, 408 m, Soldevilla et al. 2017), and calls recorded beyond the 300-m isobath (Rice et al. 2014). One unconfirmed sighting of a Gulf of Mexico whale during surveys in August 2018 occurred at a depth of 316 m. Although the information collected during those surveys was insufficient to verify the sightings to species, there is a high level of confidence that this was a Gulf of Mexico Bryde's whales (Mullin pers. comm.).

Širović et al. (2014) have reported Gulf of Mexico whale call types composed of down-sweeps, triangulating on the location of the calls and confirming the location with visual sightings. Rice et al. (2014) have also detected these down-sweep sequences, along with a distinctive "long-moan" sequence sound, in the northeastern Gulf of Mexico (Rice et al. 2014). Although the

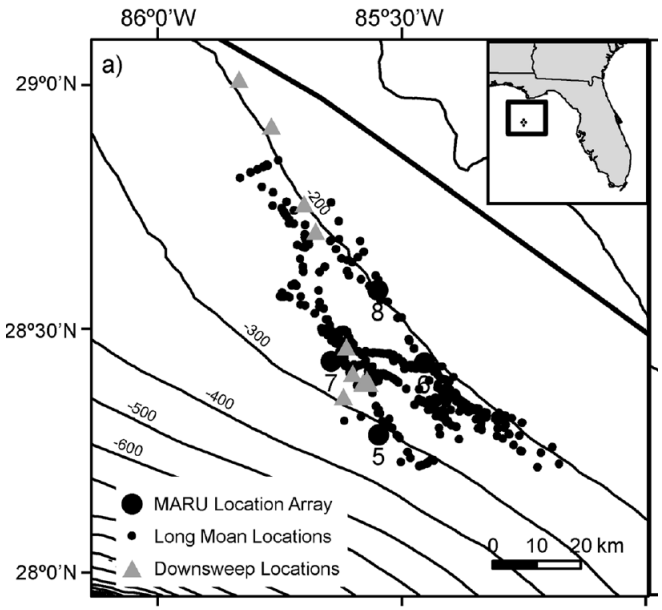

Figure 4. Positions of acoustically located "long-moan" and "down-sweep" sequence sounds. From Rice et al. 2014.

majority of calls were located between the 200-m and 300-m isobaths, several locations of the long moan sequences were between the 300-m and 400-m isobaths (Fig 4).

In 2019, NOAA released a map of the current core distribution area of the Gulf of Mexico whale based on visual sightings and tag data (Fig. 5). Trimmed on the western side to the 410-m isobath, the polygon includes a 10-km buffer to capture uncertainty in position data, followed by a 20-km buffer to account for the possible movement that whales could make in any one direction from an observed sighting (see metadata at https://www.fisheries.noaa.gov/resource/map/gulf-mexico-brydes-whale-core-distribution-area-map-gis-data). This polygon represents the most up-to-date map for the core distribution of the whale, extending the isobath to 410 m from the BIA's 300-m isobath.

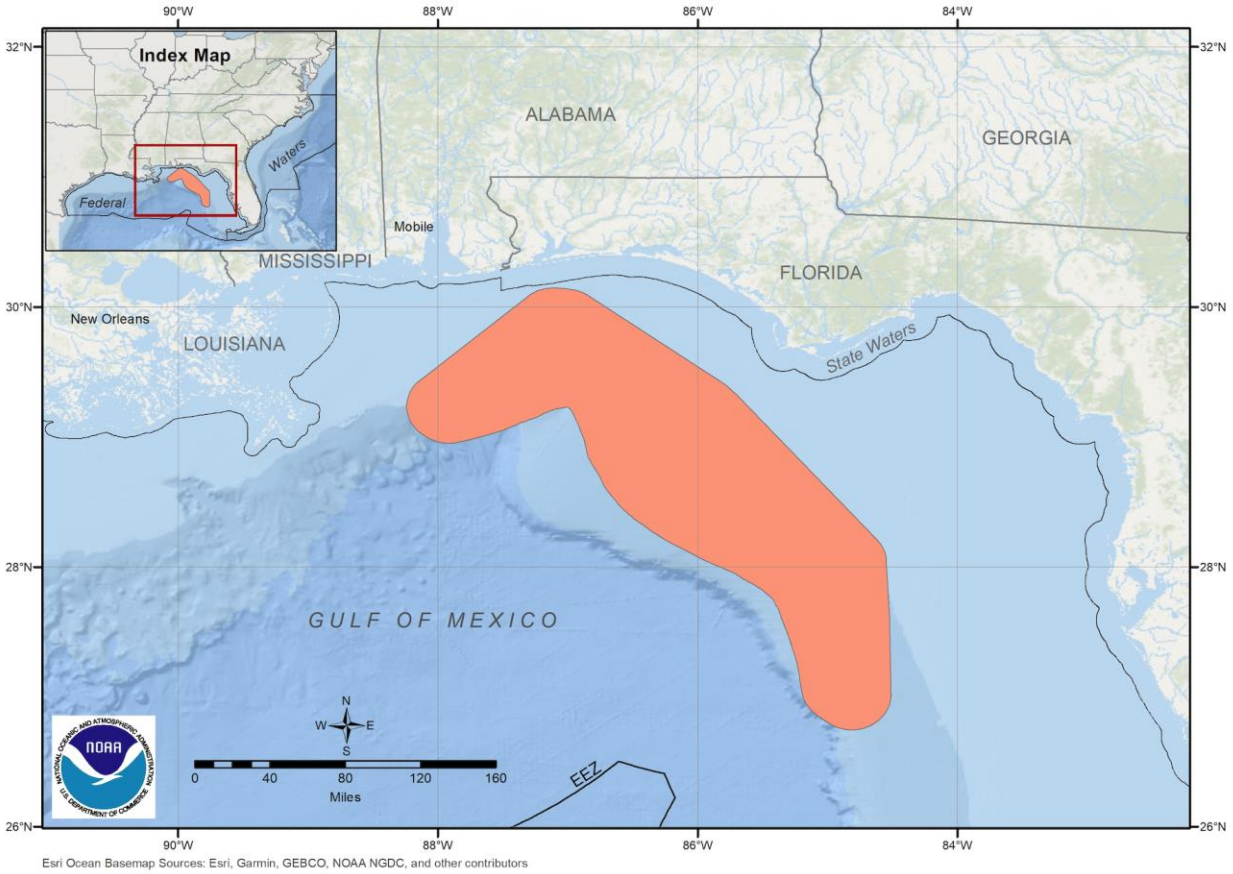

Figure 5. The core distribution area of the Gulf of Mexico whale, as determined by NOAA in June 2019 (from https://www.fisheries.noaa.gov/resource/map/gulf-mexico-brydes-whale-core-distribution-area-map-gis-data).

This core distribution area overlaps significantly with our proposed critical habitat, though it does not include sightings and historical records to the west of this core area and results from the density model as composed by Roberts et al. (2015, 2016), as further discussed below. The proposed critical habitat (Fig. 1) is reflected in the Gulf of Mexico whale study area currently being conducted under the NOAA RESTORE Science Program (Trophic Interactions and Habitat Requirements of Gulf of Mexico Bryde's Whales). That research group's polygon is remarkably similar to the one described in this report, extending from south Florida to south Texas based on sightings and, presumably, bathymetry (Fig. 6).

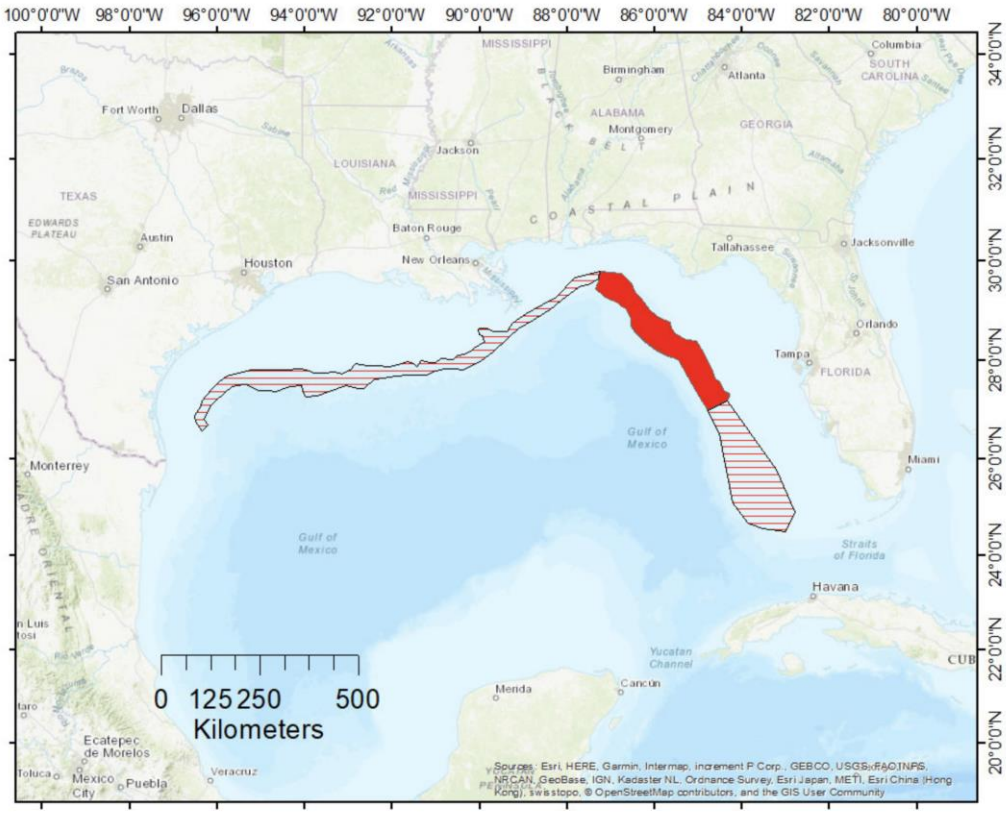

Figure 6. Primary Gulf of Mexico whale study area in solid red and full study area in hatched red. Study area is based on previously documented whale sightings (https://restoreactscienceprogram.noaa.gov/projects/brydes-whales).

(b) *Additional critical habitat*

Based on the best available scientific data, the Gulf of Mexico whale has undergone a range contraction. In U.S. waters, the most notable difference in distribution is the decline of the whale in shelf waters south and west of the Mississippi River Delta, of which logbooks contain numerous records (Rosel and Wilcox 2014, Rosel et al. 2016). The primary range is now largely restricted to the northeastern Gulf of Mexico, with several sightings to the west that offer a compelling case for the whale's presence off Texas and Louisiana. As the Status Review Team has noted, the limited distribution of the whale indicates that regulatory mechanisms have not been sufficient to maintain the population after the widespread expansion of energy exploration and production in the 1950s and increasing shipping traffic (Rosel et al. 2016). Even its core area is at risk from potential future energy exploration and ship strikes.

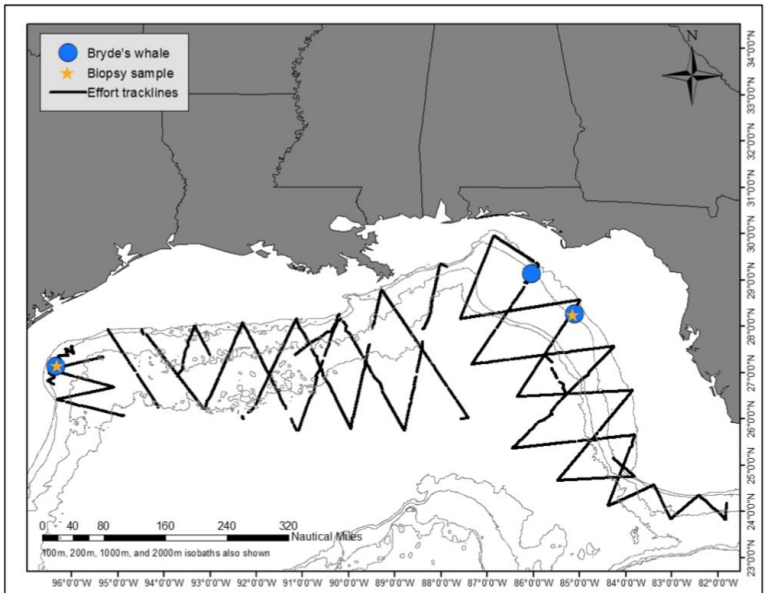

Figure 7. Track lines and confirmed sighting of a Gulf of Mexico whale off the coast of Texas from the NOAA Ship *Gordon Gunter* Cruise in 2017 (US Department of Commerce 2018).

As discussed below, several lines of evidence indicate that the critical habitat essential to the survival and recovery of the Gulf of Mexico whale should extend beyond De Soto Canyon and surrounding waters. We propose that the designation of critical habitat for the Gulf of Mexico whale should extend from south Florida to south Texas between the 100-m and 500-m isobaths (Fig. 1). Support for this designation comes from multiple lines of evidence including aerial and shipboard surveys and opportunistic sightings (Rosel et al. 2016), passive acoustic recordings (Rice et al. 2014, Širović et al. 2014), habitat-based density models, and historical records (Reeves et al. 2011).

Surveys and sightings

Several sightings of baleen whales have occurred to the west of the core area, at least one confirmed and a few unverified at the population or species level (Figs. 1 and 7). NMFS surveys between 1991 and 2015 have recorded three baleen whales outside the BIA—a fin whale identified during an aerial survey in 1992 off Texas and two sightings of Bryde's/sei whales in 1992 and 1994 along the shelf break in the western Gulf of Mexico during GulfCet surveys (NOAA 2019a). In 2015, a citizen sighted and photographed what most experts think was a Bryde's whale in the western Gulf of Mexico south of the Louisiana-Texas border (reviewed in Rosel et al. 2016). In addition to these sightings, PSOs (protected species observers placed on seismic survey vessels) have indicated that sei/Bryde's whales occur outside of the BIA. (PSO sightings are often made at long distances, making confirmed species identifications challenging.)

During a 2017 cruise aboard the *Gordon Gunter*, a single Gulf of Mexico whale was sighted in the western Gulf of Mexico (Fig. 7, coordinates 27°13' N, 96°33' W). Genetic analysis of this individual confirmed its identification as a Gulf of Mexico whale, one that had not been biopsied

in the past (Rosel pers. comm.). Whether the confirmed whale is a lone resident of the area, part of an unidentified subpopulation, or part of the eastern group is unknown at this point.

That many of these sightings are considered likely to be Bryde's whales, and have been found in the same depth profile as the other Gulf of Mexico whales, provides support for extending the critical habitat of this species to the west of the core area. These sightings support designating the shelf break from south Florida to south Texas as critical habitat for the Gulf of Mexico whale.

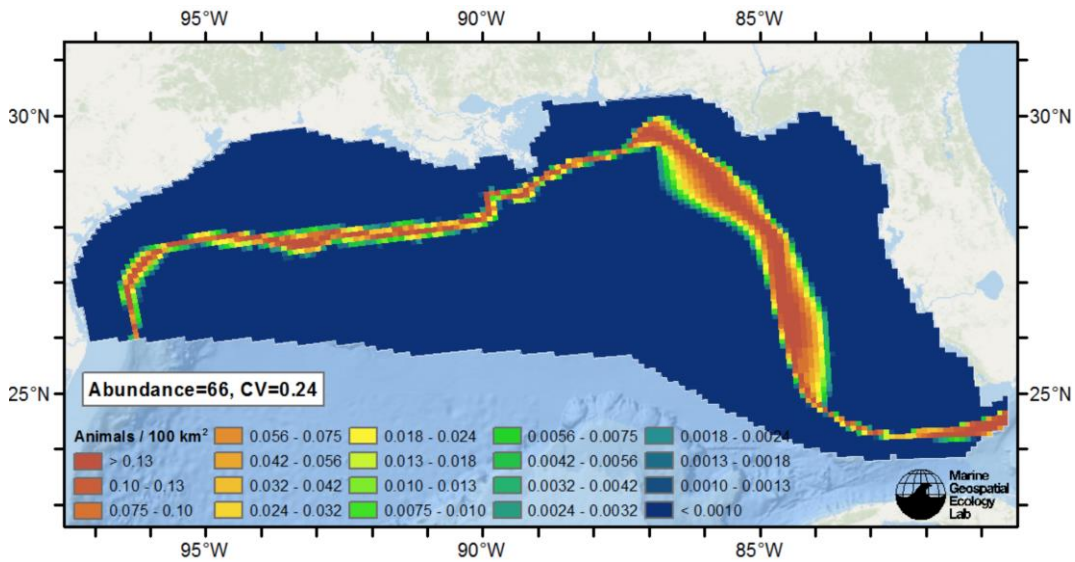

Figure 8. Gulf of Mexico whale density predicted by a climatological model constructed by Roberts et al. (2015). This version, not included in the final publication, includes sightings west of Louisiana.

Density models

The density model constructed at the Duke University Marine Geospatial Ecology Lab integrated survey data with oceanographic and biological covariates obtained from remote sensing and ocean models to develop habitat-associated density for the Gulf of Mexico whale (Roberts et al. 2015, 2016). The model identifies the geographic extent of suitable habitat where whales are predicted to be present as well as the predicted density in that habitat. The map shown in Figure 8, which was provided by the Geospatial Ecology Lab, is different from the one in Roberts et al. (2016), as it includes the sightings from 1992 and 1993 and encompasses the 2017 sighting. This last confirmed sighting is consistent with the depth covariate used in the model, which generally runs to the 500-m isobath. Based on these factors, the model predicts higher density of Gulf of Mexico whales along the shelf break, from Florida to Texas.

Only the area extending to the east, between approximately 81º and 84º west, is based solely on the density model in Roberts et al. (2016). Although no whales have as yet been confirmed in that area, environmental variables indicate that it could provide high-value habitat.

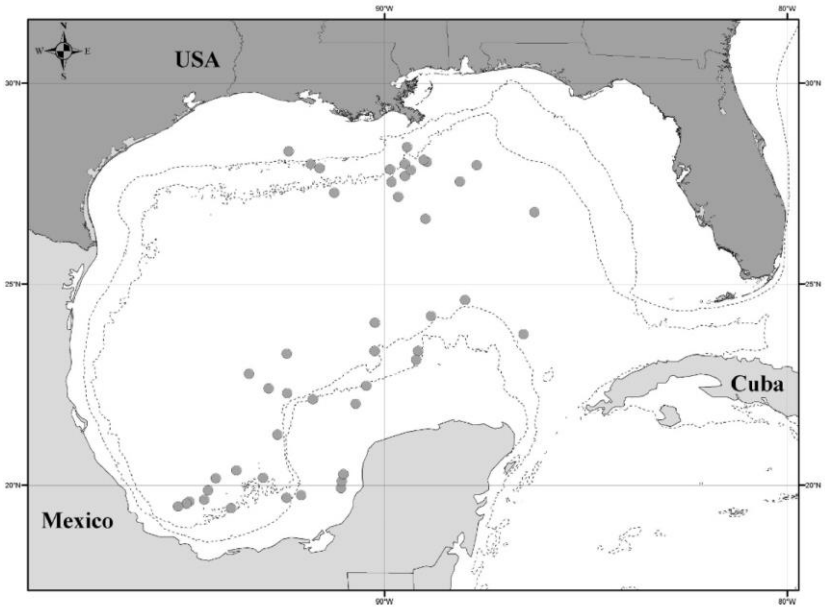

Figure 9. Daily positions recorded in whaling logbooks on days when "finbacks," generally considered to be Gulf of Mexico whales, were caught or sighted in the Gulf of Mexico. Dotted lines indicate the 100-m and 1000-m isobaths. From Reeves et al. 2011.

Historical evidence

Although the majority of recent sightings of the Gulf of Mexico whale occur in the northeast corner of the gulf, historical records suggest that this species was once much more widespread, occurring in depths that may be as shallow as 20 m or less and deeper than 3,500 meters. The majority of historic records occurred in areas that were further offshore and to the south and west of De Soto Canyon (Reeves et al. 2011). Many of the historic records come from whaling data that were compiled by Judith Lund and Tim Smith in collaboration with the Mystic Seaport Museum and the New Bedford Whaling Museum (see whalinghistory.org). Reeves et al. (2011) analyzed these data for cetaceans in the Gulf of Mexico. In addition to sperm whales, they found records of approximately 50 "finbacks" that were caught or sighted in the Gulf (Fig. 9).

There is general agreement that these historic records are of a *Balaenoptera* species, specifically the Gulf of Mexico whale, as they are the most common baleen whales in the region and the only known residents (Reeves et al. 2011, Würsig et al. 2000). Reports of finbacks in the logbooks suggest a distribution that was much broader than the current known area, encompassing much of the north-central and southern Gulf (Fig. 9). In addition to the Bryde's whale, four species of *Balaenoptera* whales have been documented in the Gulf: the blue whale (*B. musculus*), fin whale (*B. physalus*), sei whale (*B. borealis*), and common minke whale (*B. acutorostrata*) (Jefferson and Schiro 1997). Except for the Gulf of Mexico whale, these species are regarded as "extralimital, strays from migration, or occasional migrants" (Mullin and Fulling 2004). None of them were sighted during ship-based line transect surveys conducted between 1996 and 2001.

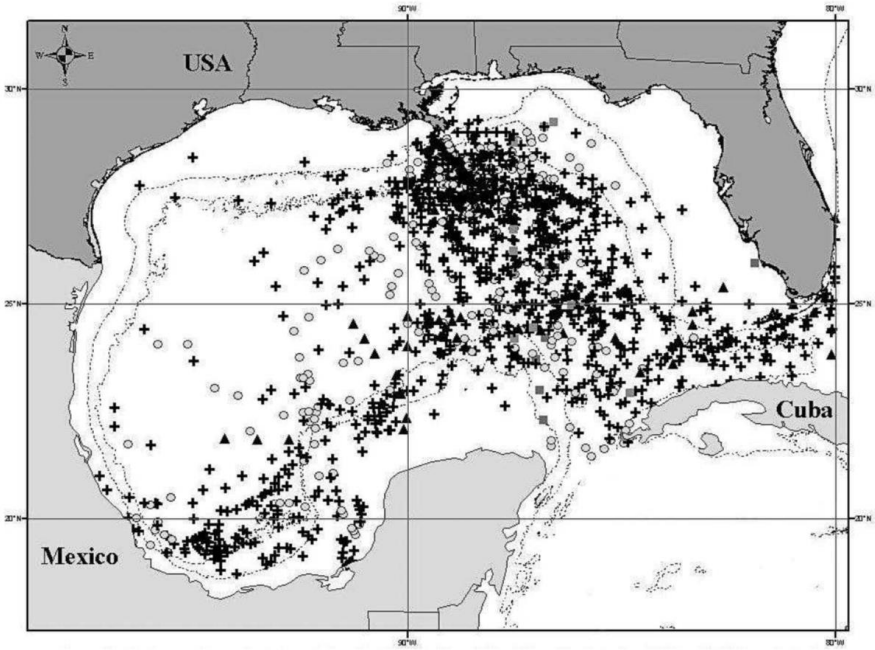

Figure 10. Daily positions of American whaling vessels. Circles represent the months of January to March, crosses April to June, and triangles July to September. From Reeves et al. 2011.

We analyzed the depth profiles for these historical records and found that they ranged from 11 m to 3,761 m, with a mean of 1491 m and a median of 1324 m. Depth profiles in this case are approximate, as positions were taken daily rather than at the time a whale was sighted or killed. No whales were recorded in the eastern Gulf, which likely reflects a low level of effort rather than an absence of the species in the area during the nineteenth century (cf. Fig. 10).

Rosel and Wilcox (2014) examined these findings and concluded that the "most notable difference in distribution between contemporary and historic records lies in shelf waters south and west of the Mississippi River Delta, of which logbooks contain numerous records." The presence of this species outside the current core area, with many records clustered around the 100-m to 1000-m isobath, indicates that a range contraction has likely occurred, perhaps because of direct hunting and habitat degradation. Recovery will at least require protecting the core habitat of the Gulf of Mexico whale, extending to the west to account for recent and historical sightings; but, in light of the probable range contraction, this area must be regarded as the absolute minimum needed and periodically reviewed for expansion consistent with recovery.

(c) *Areas outside of the proposed critical habitat that merit further study*

Studies conducted by NMFS, the Bureau of Ocean Energy Management (BOEM), and their collaborators provide detailed and well-established support for the importance of the shelf break (conservatively set at a depth of 100 to 500 m) to the Gulf of Mexico whale. As detailed above, this support includes evidence from aerial surveys, shipboard surveys, passive acoustic analyses, density models, and other field-based and analytical tools. The bathymetric profile of this area has been well established from satellite gravity models based on raw soundings from a variety of sources, including NOAA (Becker et al. 2009).

Designating critical habitat along the 100-m to 500-m isobath from southern Florida to the Texas and Mexico border retains the physical features that are essential for the conservation of Bryde's whales. This determination is more extensive than the whales' present core range, in that it extends critical habitat across the depth profile in the Gulf of Mexico, but it is also conservative, in that it does not include the far wider bathymetry that the Gulf of Mexico whale appears to have used in the past. As discussed above, we analyzed the whaling data compiled by Reeves et al. (2011) and found that the range may have varied from approximately 10 meters to deeper than 3,700 meters (Figs. 1 and 9). Although we cannot expect the coordinates from historical records to be as accurate as modern-day GPS coordinates, whaling records do provide valuable insight into the past distribution and hunting history of the great whales in the Gulf of Mexico and around the world (Reeves et al. 2011, Smith and Reeves 2012).

This report is based on contemporary and historical sightings; for that reason, the proposed critical habitat does not include the entire buffer zone as designated by NMFS in the whale's core distribution area (Fig. 5). As the population grows and recovers, it is likely that additional habitat will be necessary, and we encourage the Service to consider enlarging our proposed area through the inclusion of buffer zones to account for lateral movement of individual whales and other matters as new information arises. There is ample information from whaling, for example, that the Gulf of Mexico whale was found in deeper waters, especially south of the Mississippi. As the population expands, and if more suitable habitat becomes available, it would not be surprising to see these whales return to historic areas or expand into previously unknown ones. As progress continues toward recovery, a review should be conducted regularly for adaptive management purposes to assess the effectiveness of a relatively restricted critical habitat, taking both historical evidence and new scientific monitoring efforts, such as through the use of passive acoustics, into account.

Although the Gulf of Mexico whale's known range is generally restricted to the northern Gulf of Mexico, there are a few stranding records for Bryde's whales along the southern U.S. Atlantic coast (Rosel et al. 2016). Two of the stranded whales were genetically identified as belonging to the Gulf of Mexico whale outside of the Gulf; travel beyond their range might have increased the whales' vulnerability to mortality and stranding. We also recognize that it is possible that the Gulf of Mexico whale's range extends into the southern Gulf. There was at least one sighting of a possible Gulf of Mexico whale during oceanographic surveys in the southwest Gulf of Mexico (Ortega-Ortiz 2002, Rosel et al. 2016). More effort surveying the potential southern range of the whale could help with species-level conservation efforts.

3. The Proposed Areas Contain Physical and Biological Features Essential to the Conservation of the Species

The following physical or biological features of the Gulf of Mexico whale's habitat support its ability to communicate, forage, travel, and move through the waters of the Gulf of Mexico and are essential to the conservation of the species.

Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth
Gulf of Mexico whales need to maintain their energy balance to support daily activities such as foraging and traveling and for growth, gestation, and lactation.

According to the review conducted by the Status Review Team, there is little information on the foraging ecology of the Gulf of Mexico whale (Rosel et al. 2016, NMFS 2019). In general, however, Bryde's whales are considered efficient and adaptable predators, adopting behaviors in relation to local prey species, feeding grounds, and the marine environment (Constantine et al. 2018). They feed at a constant and high rate throughout the year, with feeding events that typically involve multispecies aggregations (Penry et al. 2016).

Tracking data from a single Gulf of Mexico whale with an acoustic tag showed diving depths of up to 271 m during the daytime, with foraging lunges occurring at the deepest part of the dive (Soldevilla et al. 2017). The whale was likely foraging at or just above the sea floor, where schooling fish form tight aggregations during the day. Other populations of Bryde's whales are thought to feed primarily in the water column on small crustaceans and schooling fish such as anchovy, sardine, and mackerel (Kato 2002), prey that occurs in the core of the whale's known range and throughout much of the Gulf of Mexico (Grace et al. 2010). The tracked Gulf whale remained close to the surface in the evening, a pattern consistent with other populations; Bryde's whales in the shallow waters of the Hauraki Gulf, for example, showed foraging behavior during the day and rest during the night (Izadi et al. 2018).

Given the many observations of the Gulf of Mexico whale between the 100-m to 500-m isobaths, it is apparent that this population has adapted to the prey species and conditions consistent with this environment. Additional research is required to examine prey availability and distribution throughout the year.

Acoustic conditions that support the whales' habitat use and occupancy
An important aspect of critical habitat for the Gulf of Mexico whale is the maintenance of sound levels that do not impair its use or occupancy. The Gulf of Mexico experiences high levels of hydrocarbon exploration and extraction, and it has several heavily used commercial shipping ports: 10 of the top 13 ports in the United States, as ranked by total handled tonnage, are located in the Gulf (Strocko et al. 2014, Wiggins et al. 2016). A large fishing industry also occurs in the region. All of these activities contribute to oceanic noise.

Cetaceans can experience temporary and permanent hearing loss when exposed to high sound levels (Southall et al. 2008), and the masking of vocalizations, disruption of biologically meaningful behavior, and habitat displacement have been documented in other baleen whales as a result of seismic surveys (e.g., Blackwell et al. 2015, Castellote et al. 2012, Cerchio et al. 2014). Shipping noise can mask the calls of baleen whales (e.g., Clark et al. 2009, Hatch et al. 2012) and has been associated with indicators of chronic stress in these species (Rolland et al. 2012). Notably, Gulf of Mexico whale vocalizations, modeled by Wiggins et al. (2016) with a source level of 152 dB in the 100 Hz 1/3-octave band, overlap strongly with both commercial shipping and seismic airgun noise, leaving the species highly vulnerable to masking and other effects.

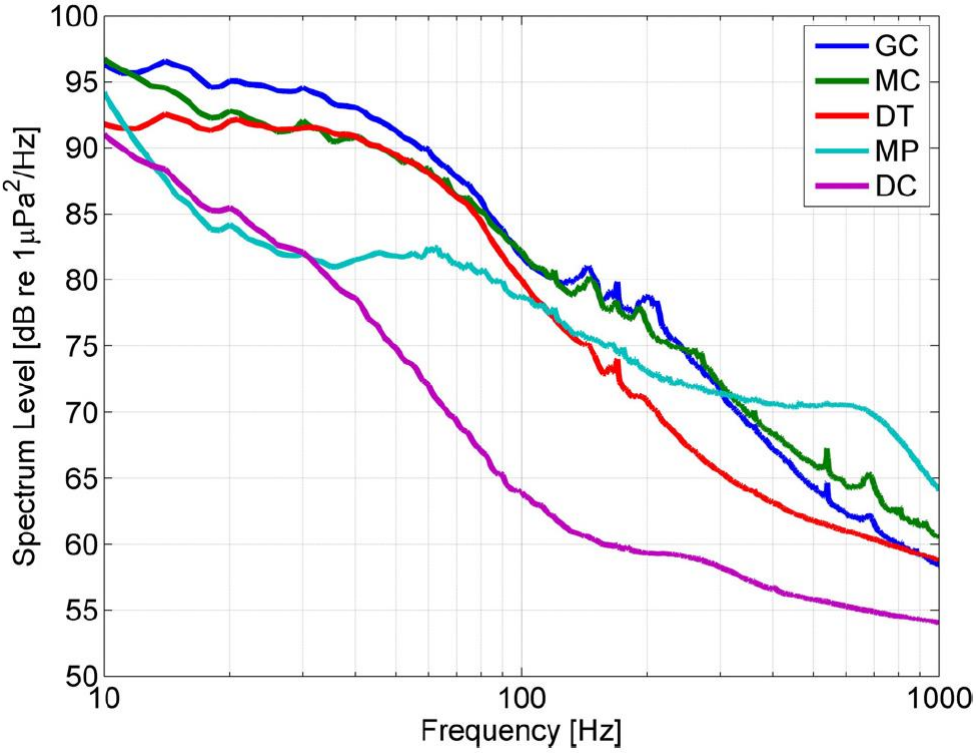

Figure 11. Average sound pressure spectrum levels in the Gulf of Mexico. High-frequency acoustic recording packages were deployed at five sites: Green Canyon (GC), Mississippi Canyon, (MC), Main Pass (MP), De Soto Canyon (DC), and Dry Tortugas (DT). From Wiggins et al. 2016.

Acoustic disturbance may already affect the population's habitat use and occupancy. Wiggins et al. (2016) examined spectral density levels at five sites in the Gulf of Mexico; they found that the core of the whale's range, centered around De Soto Canyon, has relatively low sound-pressure levels, which might provide an acoustic refuge for the population (Fig. 11). By contrast, deep-water sites elsewhere in the Gulf have high sound-pressure spectrum levels caused by seismic exploration, shipping, fishing, and other human activities (Wiggins et al. 2016). According to whaling records, Bryde's whales were once relatively common around the Mississippi Canyon and surrounding waters. The historical evidence suggests that anthropogenic noise and other human activities have contributed to the contraction of the population's range (Rosel and Wilcox 2014, Rosel et al. 2016), indicating that sound is an essential habitat feature for the conservation of the Gulf of Mexico whale.

Such a feature aligns with NMFS's critical habitat designation for the Main Hawaiian Islands insular false killer whale, which considered sound levels that will not significantly impair the whales' use or occupancy as an essential feature of their habitat (NOAA 2018).

Water quality to support growth and development
The Gulf of Mexico whale requires waters that are free of harmful pollutants. Oil spills and spill response are significant threats that have modified the whale's habitat in the past (Rosel et al. 2016). In particular, the 2010 Deepwater Horizon oil spill released nearly 134 million gallons (507 million liters) of oil into the Gulf of Mexico, affecting 48 percent of the Gulf of Mexico whale's Biologically Important Area (NOAA 2019). NOAA estimated that 17 percent of the population died in the spill, that 22 percent of reproductive females experienced reproductive failure, and that 18 percent of the population has suffered adverse health effects due to lung and adrenal disease and poor body condition (DWH MMIQT 2015, DWH NRDA Trustees 2016). These issues persist. In the two years following the Deepwater Horizon spill, 46 oil spills of more than 1000 barrels were associated with oil and gas activities in the Gulf of Mexico (Bureau of Ocean Energy Management & Gulf of Mexico OCS Region 2015, Rosel et al. 2016).

Space for population growth
The majority of recent sightings of the Gulf of Mexico whale are located around the core area of De Soto Canyon (Fig. 1). Given the need for food and reproduction, it is highly likely that this area is too small to sustain or recover a baleen whale population. Historical records show that the Gulf of Mexico whale was once much more widespread than it is today, and recovery would likely see the population expand out of its currently restricted area. High levels of industrial activity off the coast of Louisiana and Texas may have displaced the Gulf of Mexico whales from these waters in the twentieth and twenty-first centuries (Rosel et al. 2016). The critical habitat proposed here is based on recent observations, historical records, and data from the density model. We believe it represents the bare minimum of habitat necessary for recovery.

4. Designated Critical Habitat Is Prudent and Determinable

Under section 4 of the Endangered Species Act, critical habitat should be designated "to the maximum extent prudent and determinable" at the time a species is listed as threatened or endangered (16 U.S.C. 1533(b)(6)(C)). Under the Act, a designation is not considered prudent if it will increase risks or not be beneficial to the species. It is not considered determinable if the biological needs of the species are not sufficiently well known to make a determination or if there is insufficient information to analyze the impacts of the designation.

The proposed critical habitat is prudent. There is no basis for assuming that the identification of the area will increase any threats to the Gulf of Mexico whale. On the contrary, the designation of the habitat will be beneficial to the species by helping to safeguard its home range, and increased long-term protection of the whales is not merely beneficial, but critical to their survival. As NMFS has noted, the species is at high risk of extinction because of its limited range, small population size, and a cluster of anthropogenic threats, including ocean noise and catastrophic events such as oil spills. The protection of habitat outside the area presently considered the core range would help offset some of the extinction risks that a single, localized catastrophic event—such as an oil spill—would constitute for the population.

The requested critical habitat designation is determinable because there is sufficient information showing the reliance of the Gulf of Mexico whale on the area around De Soto Canyon and on the 100-m to 500-m isobath. This report and many source materials, both contemporary and

historical, support such a designation. We consider a designation based on the 100-m to 500-m isobath to be both prudent and determinable.

5. Areas Identified Require Special Management and Protection

Habitat critical to the Gulf of Mexico whale is threatened by a number of anthropogenic activities. Much of the guidance for this section comes from NOAA's 2016 Status Review. According to the Status Review Team, the greatest threats to the Gulf of Mexico whale include present or threatened destruction, modification, or curtailment of habitat; energy exploration, development, and production; oil spills and spill response; harmful algal blooms; persistent organic pollutants; and heavy metals (Rosel et al. 2016). In particular, the Review Team found that energy exploration, development, and production posed a severe risk with a high level of certainty to the Gulf of Mexico whale's habitat and the curtailment of its range (Rosel et al. 2016, Appendix 3).

In addition to the threats associated with anthropogenic noise (discussed below and in Section 3 above), we include three broad topics of concern for the continued existence of the Gulf of Mexico whale: collisions with vessels, fisheries, and military testing and training.

Anthropogenic noise
The Gulf of Mexico is one of the world's noisiest seas at low frequencies because of oil and gas energy exploration and shipping activities (Rosel et al. 2016). Airgun noise has been shown to disrupt important behaviors in baleen whales and can mask their vocalizations due to the overlap in their frequencies. The small population size and restricted range of the Gulf of Mexico whale increase the potential for serious impacts from these effects, resulting in what NMFS's Status Review Team characterized as a high threat to the Gulf of Mexico whale.

Although there were 48 active leases in the Eastern Planning Area (EPA) as of 2016, most of the core habitat area falls under a moratorium on new lease sales established through the Gulf of Mexico Energy Security Act (Rosel et al 2016). The moratorium within this planning area does not preclude energy exploration, however; thus, seismic survey activity can occur within the EPA, affecting the species in its core habitat (NOAA 2019). The moratorium expires in 2022, and Congress has the option of opening more of the EPA to oil and gas activities. The Status Review Team raised significant concerns about the expiration of the moratorium and the potential impacts on the future of the Gulf of Mexico whale if these waters are opened to development (Rosel et al. 2016). These concerns were reflected in the final rule to list the Gulf of Mexico whale (NOAA 2019).

On a broader scale, the Status Review Team expressed concern about the role of energy exploration, development, and production in curtailing the whale's range. Historically, the Mississippi Canyon may have been important for Gulf of Mexico whales, but current noise levels and human activities could restrict their use of the area. Large marine structures and long-term acoustic disturbance can present obstacles to whale movement (see, for example, the final rule to designate critical habitat for the Main Hawaiian Islands insular false killer whale, NOAA 2018). These obstacles, which are prevalent in the Central Planning Area, could displace whales

from the productive Mississippi Canyon and surrounding waters or interrupt movement between the eastern and western parts of their range.

The Status Review Team attempted to determine the range of noise levels that Gulf of Mexico whales may be experiencing throughout the Biologically Important Area. Using data from the CetSound project (cetsound.noaa.gov), the team estimated that 95% of the BIA had shipping noise levels of 73.2 dB or higher, 50% of the area was predicted to have shipping noise levels of 82.2 dB re 1 μPa or higher, and 5% of the area was predicted to have shipping noise levels of at least 87.6 dB re 1 μPa (Rosel et al. 2016). These modeling results, which looked at noise levels summed over multiple frequencies, indicate that the noise contribution from shipping may be higher in the BIA than in the rest of the Gulf of Mexico. The Review Team also modeled seismic survey noise levels in the BIA; it noted that the results, based on 2009 data when seismic activities were more extensive than usual, are likely not representative of what Gulf of Mexico whales experienced in the years that immediately followed. They could, however, reflect the noise in the area if, for example, the Eastern Planning Area were opened to seismic surveys.

Collisions with vessels

Soldevilla et al. (2017) reviewed the potential risks of vessel strikes and fisheries interactions to the Gulf of Mexico whale, noting that vessel collisions could be an important source of anthropogenic mortality for the species. These collisions can lead to mortality or serious injury from blunt-force trauma when the hull of the vessel collides with a whale or sharp-force trauma from propeller cuts. At least 25 Bryde's whale vessel collision mortalities have been documented worldwide, with 68% of these occurring in Hauraki Gulf, New Zealand (Constantine et al. 2015). At least one mortality of a Gulf of Mexico whale, a lactating female in 2009, has been attributed to ship strike (NOAA MMHSRP 2015).

Vessel traffic and fishery effort are relatively low in the core of the whale's known range, but several shipping lanes, including those out of Tampa and other eastern ports, transit through the habitat; there is also a reef-fish bottom longline fishery active in the area (Soldevilla et al. 2017). Beyond this core, traffic density is high across much of the 100-m to 500-m isobath, especially outside of the busy ports of southern Louisiana, Houston, and Corpus Christi (Fig. 12). Such activity is of high concern given the available tagging data on diving behavior in Gulf of Mexico whales. One tagged Gulf of Mexico whale spent 88% of its nighttime activity near the surface within the draught depths of most large commercial vessels (Soldevilla et al. 2017).

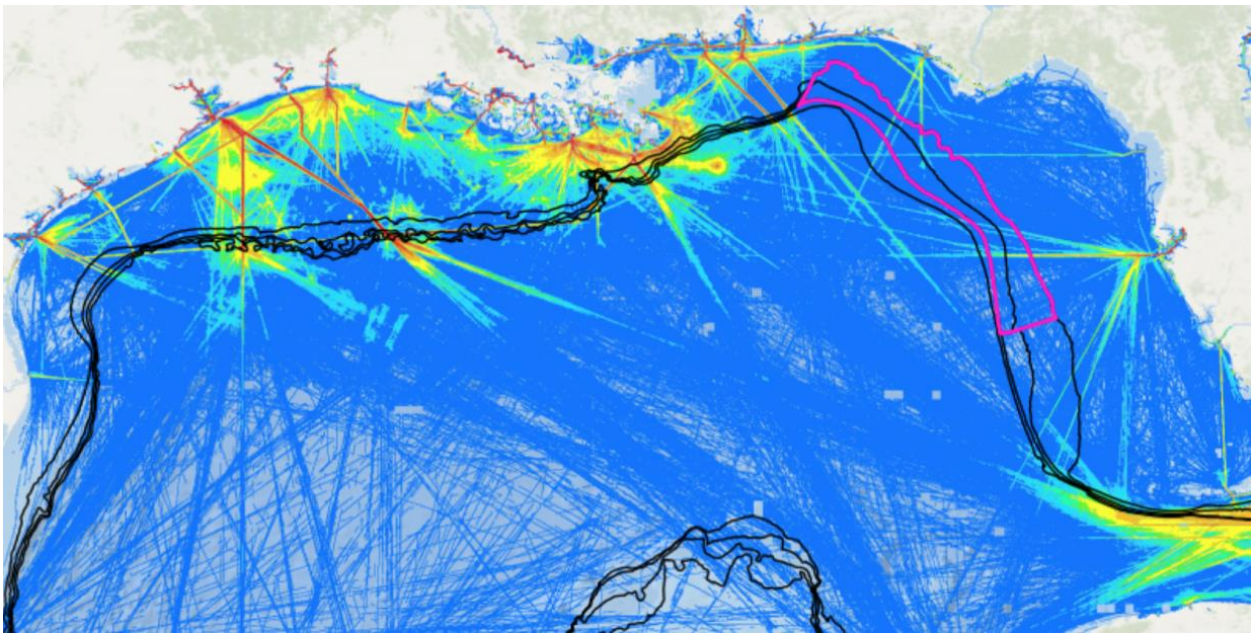

Figure 12. Northern Gulf of Mexico traffic, October 2009 to October 2010, with Biologically Important Area in pink (from Rosel et al. 2016).

Fisheries

Like other baleen whales, the Gulf of Mexico whale is susceptible to entanglement and entrapment in fishing gear. Both pelagic and bottom longline fisheries occur within the whale's habitat (Soldevilla et al. 2017). According to the Status Review Team, there are at least five fisheries in the Gulf of Mexico that could interact directly with the whales. These include pelagic longlines for tuna and billfish; bottom longlines for snappers, groupers, and other reef fish; and bottom longlines for sharks.

In Hawaii, a Bryde's whale has been documented as entangled in pelagic longline gear (Forney et al. 2011). Bottom longline gear generally poses less of an entanglement threat to cetaceans than pelagic longline gear except when cetaceans feed along the bottom, which can expose them to risks of entanglement in the mainlines (Rosel et al. 2016). Based on our limited understanding of the Gulf of Mexico whale's feeding ecology, it is certainly plausible that foraging dives occur along the bottom (Soldevilla et al. 2017).

There has been no reported fishing-related mortality or serious injury of the Gulf of Mexico whale between 1998 and 2015 (Hayes et al. 2019). Fishery effort is relatively low in the core of the Gulf of Mexico whale's known range, but is not entirely excluded. The De Soto Canyon Marine Protected Area is closed to pelagic longline fishing year-round, an area that covers two-thirds of the Gulf of Mexico whale's BIA. Approximately 50% of whale sighting locations are within this MPA (Rosel et al. 2016).

In addition to direct impacts from entanglement in active gear, Gulf of Mexico whales could be at risk from derelict or ghost gear and ecosystem-wide trophic impacts as a result of fishing and overfishing (Rosel et al. 2016).

Military testing and training
Large areas of the Gulf of Mexico are used for military testing and training. Naval testing and training exercises occur in the Gulf of Mexico Range Complex, an area that overlaps with the Gulf of Mexico whale's core range. The Navy's eastern Planning Awareness Area (locations that the Navy has identified to avoid when feasible) encompasses part of the whale's range, as does the Eglin Air Force Base Gulf Test and Training Range in the eastern Gulf of Mexico. As of 2016, activities in the Eglin Gulf Test and Training Range were not anticipated to overlap with the core range of the Gulf of Mexico whale (NOAA 2016, Rosel et al. 2016); however, NMFS' final rule on the Navy's activities, published in 2019 and covering the years 2018 through 2025, authorized 378 total takes from acoustic and explosive sound source effects by Level B harassment of Bryde's whales in the northern Gulf of Mexico (NOAA 2019). By definition, these takes are those that result in the abandonment or significant alteration of behavioral patterns such as foraging or breeding (16 U.S.C. § 1362(18)(B)(2)).

6. Conclusion

Recent sightings and models have helped define the range of the Gulf of Mexico whale, and they demonstrate the importance of this area to the population. The critical habitat proposed here, running between the 100-m and 500-m isobaths across the Gulf of Mexico, should be considered the absolute minimum necessary for the whale's recovery. Although our current understanding of the whale's distribution is that it is largely found along the shelf break, historical evidence suggests we will find that it has a wider bathymetric range than has previously been understood. If populations were to increase to more than 250 mature individuals, the threshold for a dangerously small population in NMFS' Status Review, it seems likely that the Gulf of Mexico whale would return to deeper waters of the Gulf, and perhaps even shallower waters, as reflected in historical whaling data.

Although the current industrialization of the northern Gulf makes such recolonization a challenge, the range expansion of other marine mammals, such as humpback whales on the U.S. east coast, indicates that under the right conditions and proper protections, this resident species could once again become a wide-ranging Gulf of Mexico whale, reappearing in waters beyond the confines of the core area where it now occurs. We believe that in designating critical habitat that includes the proposed Gulf of Mexico waters, NMFS can help initiate this recovery. The designation should also help focus federal, state, and private conservation and management efforts in the proposed area. Given the high risk of extinction of this small population, we consider designation urgent and essential to the continued existence of the species.

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Appendix 1

2015 Density Model for the Gulf of Mexico Bryde's Whale (*Balaenoptera edeni*)
in the Northern Gulf of Mexico

Citation: Roberts JJ, Best BD, Mannocci L, Halpin PN, Palka DL, Garrison LP, Mullin KD, Cole TVN, McLellan WM (2015) Density Model for Bryde's Whale (*Balaenoptera edeni*) in the Northern Gulf of Mexico, Preliminary Results, Version 2.2, 2015-05-14. Marine Geospatial Ecology Lab, Duke University, Durham, North Carolina.

Courtesy of Jason Roberts, Duke University Marine Geospatial Ecology Lab.

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