BLAINVILLE'S BEAKED WHALE (*Mesoplodon densirostris*):
Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Three species of *Mesoplodon* are known to occur in the Gulf of Mexico, based on stranding or sighting data (Hansen *et al.* 1995, Würsig *et al.* 2000). These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*) and Sowerby's beaked whale (*M. bidens*). Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only one known stranding of this species (Bonde and O'Shea 1989) and because it normally occurs in northern temperate waters of the North Atlantic (Mead 1989). The possibility of another unknown species of *Mesoplodon* inhabiting the Gulf has been suggested based on passive acoustic recordings (Hildebrand *et al.* 2015).
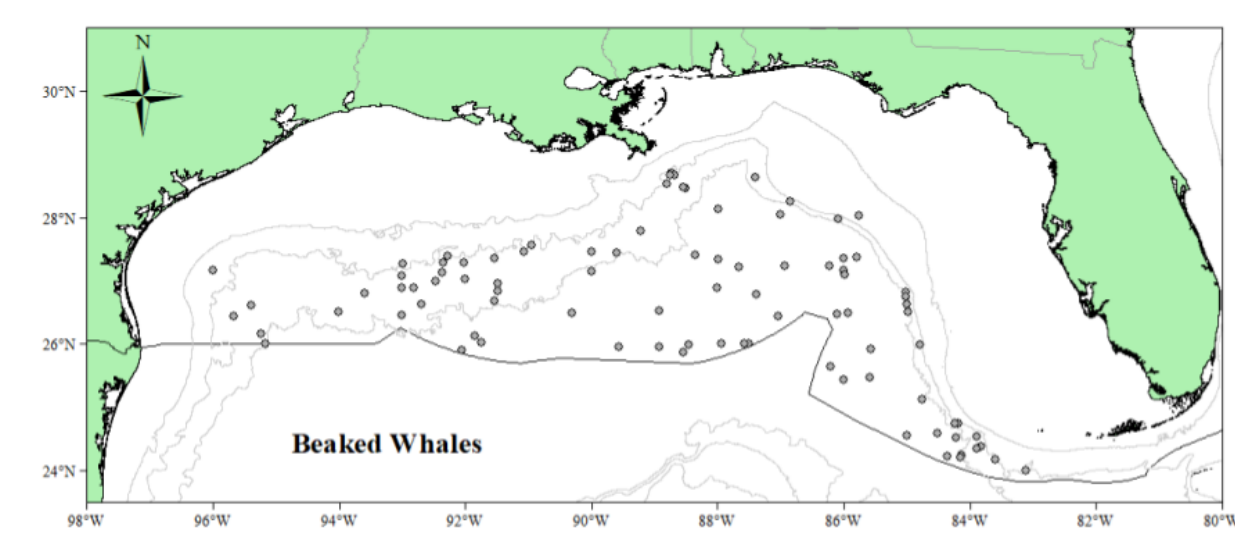

Figure 1. Distribution of beaked whale on-effort sightings from SEFSC vessel surveys during spring 1996–2001, summer 2003, spring 2004, summer 2009, summer 2017, and summer/fall 2018. Isobaths are the 200-m, 1,000-m, and 2,000-m depth contours. The darker line indicates the U.S. EEZ.

Blainville's beaked whales appear to be widely but sparsely distributed in temperate and tropical waters of the world's oceans (Leatherwood *et al.* 1976, Leatherwood and Reeves 1983). Strandings have occurred along the northwestern Atlantic coast from Florida to Nova Scotia (Schmidly 1981), and in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico; Würsig *et al.* 2000). Because at-sea identification of *Mesoplodon* to species in the Gulf of Mexico is very difficult, sightings of beaked whales (Family Ziphiidae) made during visual surveys are often identified only as *Mesoplodon* sp. or unidentified Ziphiids, and are referred to more generically as 'beaked whales.' In the northern Gulf of Mexico, beaked whales are sighted most commonly in waters ≥1,000 m and they have been seen in all seasons during aerial and vessel surveys of the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico; Hansen *et al.* 1996, Mullin and Hoggard 2000, Maze-Foley and Mullin 2006, Garrison and Aichinger Dias 2020; Figure 1). There are several confirmed sightings of Blainville's beaked whales, two in the western Gulf and one off the Florida shelf (Garrison and Aichinger Dias 2020).

All the cetacean species found in the oceanic northern Gulf of Mexico almost certainly occur in similar habitat beyond U.S. boundaries in the southern Gulf. There are fewer cetacean sighting and stranding records in the southern Gulf due to more limited effort. Nevertheless, there are records for most oceanic species in the southern Gulf (e.g., Ortega Ortiz 2002; Ortega-Argueta *et al.* 2005; Jefferson *et al.* 2008; Vázquez Castán *et al.* 2009; Whitt *et al.* 2011).

This is therefore likely a transboundary stock with Cuba and/or Mexico. Because U.S. waters only comprise about 40% of the entire Gulf of Mexico and 35% of the oceanic (i.e., >200 m) Gulf of Mexico (Mullin and Fulling 2004), abundance and stock boundaries of oceanic species are poorly known.

Blainville's beaked whales in the northern Gulf of Mexico are managed separately from those in the western North Atlantic. Although there have been no directed studies of the degree of demographic independence between the two areas, this management structure is consistent with the fact that the Gulf of Mexico and western North Atlantic belong to distinct marine ecoregions (Spalding *et al.* 2007, Moore and Merrick 2011). There are insufficient data to determine whether the northern Gulf of Mexico stock comprises multiple demographically independent populations. Additional morphological, acoustic, genetic, and/or behavioral data are needed to further delineate population structure within the Gulf of Mexico and across the broader geographic area.

POPULATION SIZE

The total number of Blainville's beaked whales in the northern Gulf of Mexico is unknown. The best abundance estimate (Nest) is for *Mesoplodon* spp., and is a combined estimate for Blainville's beaked whale and Gervais' beaked whale. The estimate of abundance for *Mesoplodon* spp. from summer 2017 and summer/fall 2018 oceanic surveys covering waters from the 200-m isobath to the seaward extent of the U.S. EEZ is 98 (CV=0.46; Table 1; Garrison *et al.* 2020). This estimate was not corrected for the probability of detection on the trackline, and is likely a severe underestimate due to the long dive times of this species. The estimate for the same time period for unidentified Ziphiids was 181 (CV=0.31), which may have also included an unknown number of Blainville's beaked whales.

Earlier Abundance Estimates

Five point estimates of all Ziphiid (i.e., unidentified Ziphiids, *Mesoplodon* spp., Cuvier's beaked whale, and Gervais' beaked whale combined) abundance have been made based on data from surveys during: 2003 (June−August), 2004 (April−June), 2009 (July−August), 2017 (July−August), and 2018 (August−October). Each of these surveys had a similar design and was conducted using the same vessel or a vessel with a similar observation platform. Surveys in 2003, 2004, and 2009 employed a single survey team while the 2017 and 2018 surveys employed two survey teams. In addition, the 2017 and 2018 surveys were conducted in "passing" mode rather than "closing" mode. Passing mode eliminates the problems of fragmented tracklines associated with using closing mode in areas with high densities of animals. When using the closing mode with the two-team method, both teams must be allowed the opportunity to see a mammal group and allow it to pass behind the ship before turning to close on it, making it difficult to reacquire the group and resulting in long periods spent chasing the group, with the increased potential for off-effort sightings. For passive acoustics, in closing mode the vessel often turns before the acoustic team is able to achieve a good localization. This is especially important for deep-diving species where visual surveys are less optimal for abundance estimates. However, passing mode can result in increased numbers of unidentified sightings and may have affected group size estimation for distant groups of dolphins and small whales. Comparisons of the survey results over the years 2003 through 2009 required adjustments for these differences. This resulted in revised abundance estimates for all Ziphiids of: 2003, N=573 (CV=0.44); 2004, N=55 (CV=0.72); and 2009, N=276 (CV=0.59; Garrison *et al.* 2020).

Recent Surveys and Abundance Estimates

An abundance estimate for *Mesoplodon* spp. was generated from vessel surveys conducted in the northern Gulf of Mexico from the continental shelf edge (~200 m isobath) to the seaward extent of the U.S. EEZ (Table 1; Garrison *et al.* 2020). One survey was conducted from 2 July to 25 August 2017 and consisted of 7,302 km of on-effort trackline, and the second survey was conducted from 11 August to 6 October 2018 and consisted of 6,473 km of on-effort trackline within the surveyed strata. Both surveys used a double-platform data-collection procedure to allow estimation of the detection probability on the trackline using the independent observer approach assuming point independence (Laake and Borchers 2004). However, there were too few sightings and too few resightings of these species to allow estimation of detection probability on the trackline. Therefore, abundance estimates were derived using MCDS distance sampling methods that accounted for the effects of covariates (e.g., sea state, glare) on detection probability within the surveyed strip (Thomas *et al.* 2010) implemented in package mrds (version 2.21, Laake *et al.* 2020) in the R statistical programming language. The surveys were conducted in passing mode (e.g., Schwarz *et al.* 2010) while all prior surveys in the Gulf of Mexico have been conducted in closing mode. The 2017 and 2018 estimates for *Mesoplodon* spp. were N=127 (CV=0.61) and N=65 (CV=0.65), respectively. The inverse variance weighted mean abundance estimate for *Mesoplodon* spp. in oceanic waters during 2017 and 2018 was 98 (CV=0.46; Table 1; Garrison *et al.* 2020). This was a combined estimate for Blainville's and Gervais' beaked whales. This estimate was not

corrected for the probability of detection on the trackline, and is likely a severe underestimate due to the long dive times of these species. The 2017 and 2018 estimates for unidentified Ziphiids were N=165 (CV=0.47) and N=193 (0.65), respectively, and the inverse variance weighted mean abundance estimate for the same time period for unidentified Ziphiids was 181 (CV=0.31), which may have also included an unknown number of Blainville's beaked whales. The 2017 and 2018 estimates for all Ziphiids (i.e., unidentified Ziphiids, *Mesoplodon* spp., Cuvier's beaked whale, and Gervais' beaked whale combined) were N=303 (CV=0.28) and N=322 (CV=0.34), respectively.

Table 1. Most recent abundance estimate (N_{est}) and coefficient of variation (CV) of Mesoplodon spp. in the northern Gulf of Mexico oceanic waters (200 m to the offshore extent of the EEZ) based on the inverse variance weighted mean from summer 2017 and summer/fall 2018 vessel surveys.

Years	Area	Nest	CV
2017, 2018	U.S. Gulf of Mexico	98	0.46

Minimum Population Estimate

The minimum population estimate (Nmin) is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for *Mesoplodon* spp. in the northern Gulf of Mexico is 98 (CV=0.46). The minimum population estimate for *Mesoplodon* spp. in the northern Gulf of Mexico is 68 (Table 2).

Current Population Trend

Using revised abundance estimates for all Ziphiids for surveys conducted in 2003 (June−August), 2004 (April−June), and 2009 (July−August; see above), and the 2017 (July−August) and 2018 (August−October) estimates for all Ziphiids, pairwise comparisons of the log-transformed means were conducted between years, and significant differences were assessed at alpha=0.10. P-values were adjusted for multiple comparisons. There were significant differences between the 2003 and 2004 estimates (p.adjusted=0.012) and the 2004 and 2018 estimates (p.adjusted=0.067; Garrison *et al.* 2020).

However, the statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long intervals between surveys. For example, the power to detect a precipitous decline in abundance (i.e., 50% decrease in 15 years) with estimates of low precision (e.g., CV>0.30) remains below 80% (alpha=0.30) unless surveys are conducted on an annual basis (Taylor *et al.* 2007). In addition, because these surveys are restricted to U.S. waters, it is not possible to distinguish between changes in population size and Gulf-wide shifts in spatial distribution.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

For purposes of this assessment, 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 life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Mesoplodon* spp. is 68. 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 optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico *Mesoplodon* spp. is 0.7 (Table 2). It is not possible to determine the PBR for only Blainville's beaked whales.

Table 2. Best and minimum abundance estimates for Gulf of Mexico Mesoplodon spp. with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) and PBR.

Nest	CV	Nmin	Fr	Rmax	PBR
98	0.46	68	0.5	0.04	0.7

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated fishery-related mortality and serious injury to this stock during 2014–2018 was presumed to be zero, as there were no reports of mortalities or serious injuries to Blainville's beaked whales or unidentified beaked whales from U.S. fisheries in the Gulf of Mexico (Table 3). Mean annual mortality and serious injury during 2014–2018 for all beaked whales due to other human-caused actions (the *Deepwater Horizon* oil spill) was predicted to be 5.2. The minimum total mean annual human-caused mortality and serious injury for beaked whales during 2014–2018 was, therefore, 5.2. This is a combined estimate for Blainville's, Gervais', and Cuvier's beaked whales. The minimum total mean annual human-caused mortality and serious injury for Blainville's beaked whale is unknown.

Table 3. Total annual estimated fishery-related mortality and serious injury for northern Gulf of Mexico Blainville's beaked whales.

Years	Source	Annual Avg.	CV
2014–2018	U.S. fisheries using observer data	0	-

Fisheries Information

There are two commercial fisheries that interact, or that could potentially interact, with this stock in the Gulf of Mexico. These are the Category I Atlantic Highly Migratory Species (high seas) longline fishery and the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fishery (Appendix III). Percent observer coverage (percentage of sets observed) for these longline fisheries for each year during 2014–2018 was 18, 19, 23, 13 and 20, respectively. There is very little effort within the Gulf of Mexico by the Atlantic Highly Migratory Species (high seas) longline fishery, and no takes of beaked whales within high seas waters of the Gulf of Mexico have been observed or reported thus far. Pelagic swordfish, tunas and billfish are the targets of the large pelagics longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to Blainville's or other beaked whales by this fishery during 2014–2018 (Garrison and Stokes 2016, 2017, 2019, 2020a, 2020b).

Other Mortality

There was one stranding of a Blainville's beaked whale during 2014–2018 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 May 2019). This stranding occurred in Florida in 2014, and it could not be determined if there was evidence of human interaction. Stranding data underestimate the extent of human and fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al.* 2012, Wells *et al.* 2015). In particular, oceanic stocks in the Gulf of Mexico are less likely to strand than nearshore coastal stocks or shelf stocks (Williams *et al.* 2011). Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al.* 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

Since 1990, there have been 13 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico, and one of these included a few Blainville's beaked whales. Between August 1999 and May 2000, 150 common bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included three Atlantic spotted dolphins, *Stenella frontalis*, one Risso's dolphin, *Grampus griseus*, two Blainville's beaked whales, and four unidentified dolphins). Brevetoxin was determined to be the cause of this event (Twiner *et al.* 2012, Litz *et al.* 2014). An UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 March 2010 and ending 31 July 2014 (Litz *et al.* 2014; https://www.fisheries.noaa.gov/national/marine-life-distress/2010-2014-cetacean-unusual-mortality-event-northern-gulf-mexico). It included cetaceans that stranded prior to the *Deepwater Horizon* (DWH) oil spill (see "Habitat Issues" below), during the spill, and after. Exposure to the DWH oil spill was determined to be the primary underlying cause of the elevated stranding numbers in the northern Gulf of Mexico after the spill (e.g., Schwacke *et al.* 2014; Venn-Watson *et al.* 2015; Colegrove *et al.* 2016; DWH NRDAT 2016; see Habitat Issues section). The 2014 stranding of a Blainville's beaked whale was considered to be part of this UME.

A population model was developed to estimate the injury and time to recovery for stocks affected by the DWH oil spill, taking into account long-term effects resulting from mortality, reproductive failure, reduced survival rates, and the proportion of the stock exposed to DWH oil (DWH MMIQT 2015). Overall, this model estimated that the stocks experienced a 6% maximum reduction in population size due to the oil spill (DWH MMIQT 2015). The mortality projected for the years 2010–2013 due to the spill has not been reported previously. Based on the population

model, it was projected that 51 beaked whales died during 2010–2013 (four year annual average of 13) due to elevated mortality associated with oil exposure (see Appendix VI). For the 2014–2018 reporting period of this SAR, the population model estimated 26 beaked whales died due to elevated mortality associated with oil exposure. However, this mortality estimate is not comparable to the current abundance estimate derived from visual surveys because the population model included a correction factor for detection probability derived from acoustic density estimates (DWH MMIQT 2015). The population model used to predict beaked whale mortality due to the DWH event has a number of sources of uncertainty. Model parameters (e.g., survival rates, reproductive rates, and life-history parameters) were derived from literature sources for beaked whales occupying waters outside of the Gulf of Mexico. In addition, proxy values for the effects of DWH oil exposure on both survival rates and reproductive success were applied based upon estimated values for common bottlenose dolphins in Barataria Bay. Finally, there was no estimation of uncertainty in model parameters or outputs.

HABITAT ISSUES

The DWH MC252 drilling platform, located approximately 80 km southeast of the Mississippi River Delta in waters about 1,500 m deep, exploded on 20 April 2010. The rig sank, and over 87 days ~3.2 million barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010 (DWH NRDAT 2016).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies were conducted to determine potential impacts of the spill on marine mammals. These studies estimated that 12% (95%CI: 2–22) of beaked whales in the Gulf, which included Blainville's, Cuvier's and Gervais' beaked whales, were exposed to oil, that 5% (95%CI: 3–8) of females suffered from reproductive failure, and 4% (95%CI: 2–7) of the beaked whale populations suffered adverse health effects (DWH MMIQT 2015). A population model estimated the stocks experienced a maximum 6% reduction in population size (see Other Mortality section above).

Anthropogenic sound in the world's oceans has been shown to affect marine mammals, with vessel traffic, seismic surveys, and active naval sonars being the main anthropogenic contributors to low- and mid-frequency noise in oceanic waters (e.g., Nowacek et al. 2015; Gomez et al. 2016; NMFS 2018). Anthropogenic noise, particularly from military sonar, shipping, and seismic testing, is an increasing habitat concern for beaked whales (Aguilar de Soto et al. 2006, Cox et al. 2006, McCarthy et al. 2011, Tyack et al. 2011, Joyce et al. 2020). Seven Blainville's beaked whales were satellite tagged and tracked in the Bahamas prior to and during naval sonar exercises (Joyce et al. 2020). Following exposure to mid-frequency active sonar, five of the whales were displaced 28–68 km from the source, and did not return for two to four days after military exercises ceased. Data also suggested the whales spent less time in deep dives during the early periods of sonar exposure (Joyce et al. 2020). In addition, several mass strandings of beaked whales throughout their worldwide range have been associated with naval activities (D'Amico et al. 2009, Filadelfo et al. 2009). In March 2000, 14 beaked whales live stranded in the Bahamas. Six of the whales (5 Cuvier's and 1 Blainville's) died and necropsy revealed evidence of tissue trauma associated with an acoustic or impulse injury that caused the animals to strand (Balcomb and Claridge 2001, NMFS 2001, Cox et al. 2006). Fourteen beaked whales (mostly Cuvier's beaked whales but also including Gervais' and Blainville's beaked whales) stranded in the Canary Islands in 2002 (Cox et al. 2006, Fernandez et al. 2005, Martin et al. 2004). Gas bubble-associated lesions and fat embolism were found in necropsied animals from this event, leading researchers to link nitrogen supersaturation with sonar exposure (Fernandez et al. 2005). The long-term and population consequences of these impacts are less well-documented and likely vary by species and other factors. Impacts on marine mammal prey from sound are also possible (Carroll et al. 2017), but the duration and severity of any such prey effects on marine mammals are unknown.

Finally, ingestion of marine debris, particularly plastics, is a concern; plastic is occasionally found in the stomach contents of stranded beaked whales.

STATUS OF STOCK

Blainville's beaked whales are not listed as threatened or endangered under the Endangered Species Act, and the northern Gulf of Mexico stock is not considered strategic under the MMPA because PBR is likely a severe underestimate due to the long dive times of this species and because the mean modeled annual human-caused mortality and serious injury due to the DWH oil spill is based on all beaked whale species combined and cannot be apportioned to individual species. No fishery-related mortality or serious injury has been observed; therefore, total fishery-related mortality and serious injury can be considered insignificant and approaching the zero mortality and serious injury rate. The status of Blainville's beaked whales in the northern Gulf of Mexico, relative to OSP, is unknown. There are insufficient data to determine the population trends for this stock.

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