GERVAIS' BEAKED WHALE (*Mesoplodon europaeus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus *Mesoplodon*, there are four species of beaked whales that reside in the northwest Atlantic. These include True's beaked whale, *Mesoplodon mirus*; Gervais' beaked whale, *M. europaeus*; Blainville's beaked whale, *M. densirostris*; and Sowerby's beaked whale, *M. bidens* (Mead 1989). These species are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only. Stock structure for each species is unknown. Thus, it is plausible the stock could actually contain multiple demographically independent populations since the current stock spans multiple eco-regions (Longhurst 1998; Spalding et al. 2007).

The distribution of *Mesoplodon* spp. in the northwest Atlantic is known principally from stranding records (Mead 1989; Nawojchik 1994; Mignucci-Giannoni et al. 1999; MacLeod et al. 2006; Jefferson et al. 2008). Off the U.S. Atlantic coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the shelf-edge and deeper oceanic waters (Figure 1; CETAP 1982; Waring et al. 1992; Tove 1995; Waring et al. 2001; Hamazaki 2002; Palka 2006). Most sightings occurred in late spring and summer, corresponding to survey effort.

Gervais' beaked whales represent a transboundary stock believed to be principally oceanic, and strandings have been reported from Cape Cod to Florida, into the Caribbean and the Gulf of Mexico (NMFS unpublished data; Leatherwood et al. 1976; Mead 1989; Moore et al. 2005; MacLeod et al. 2006; Jefferson et al. 2008; McLellan et al. 2018). This is the most common species of *Mesoplodon* to strand along the U.S. Atlantic coast.

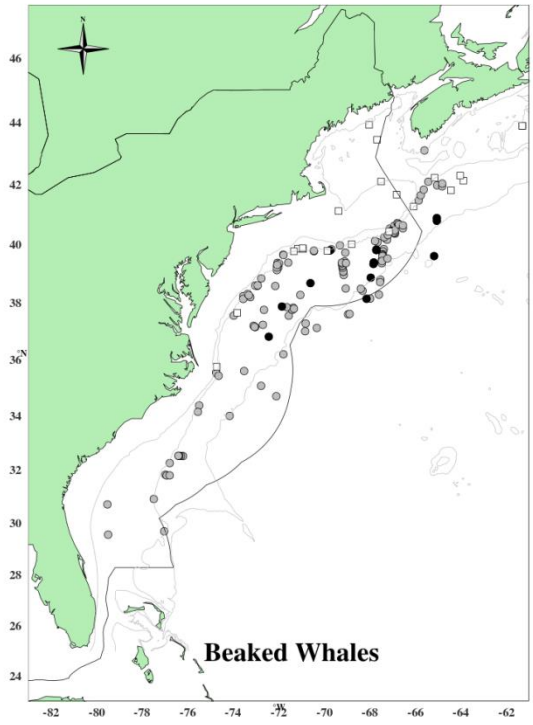

Figure 1. Distribution of beaked whale (includes* Ziphius *and* Mesoplodon *spp.) sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, and 2007, 2008, 2010, 2011 and 2016 and DFO's 2007 TNASS and 2016 NAISS surveys. Isobaths are the 200-m, 1000-m and 4000-m depth contours. Circle symbols represent shipboard sightings and squares are aerial sightings. Black symbols are sightings identified as Gervais' beaked whales.

POPULATION SIZE

The best abundance estimate for Gervais' beaked whales is the sum of the 2021 survey estimate – 8,595 (CV=0.24). This estimate, derived from shipboard surveys, covers most of this stock's known range. In the 2021 survey, improvements to field protocols for both visual observers and passive acoustic monitoring of *Mesoplodon* spp. facilitated differentiation of species during encounters. This enabled abundance estimates to be calculated for each species individually rather than grouping together at the genus level.

Recent Surveys and Abundance Estimates

Abundance estimates of 6,760 (CV=0.37) and 3,347 (CV=0.29) undifferentiated beaked whales (*Ziphius* and *Mesoplodon* spp.) were generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2016 (Table 1; Garrison 2020; Palka 2020). One survey was conducted from 27 June to 25 August in waters north of 38ºN latitude and consisted of 5,354 km of on-effort trackline along the shelf break and offshore to the outer limit of the U.S. EEZ (NEFSC and SEFSC 2018). The second vessel survey covered waters from Central Florida to approximately 38ºN latitude between the 100-m isobath and the outer limit of the U.S. EEZ during 30 June–19 August. A total of 4,399 km of trackline was covered on effort (NEFSC and SEFSC 2018). Both surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and

Borchers 2004). Mark-recapture distance sampling was used to estimate abundance. Estimates from the two surveys were combined and CVs pooled to produce an abundance estimate for the stock area, yielding a combined total of 10,107 *Mesoplodon* beaked whales (CV=0.27). These estimates are known to be biased low due to the fact that unidentified Ziphiidae abundance was estimated at 3,755 (CV=0.42) in the NE and at 2,812 (CV=0.43) in the SE. These estimates likely include an unknown number of *Mesoplodon* beaked whales.

A more recent abundance estimate of 8,595 (CV=0.24) Gervais' beaked whales was generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2021 (Table 1; Garrison and Dias 2023; Palka in prep.). One survey was conducted from 16 June to 23 August in waters north of 36ºN latitude and consisted of 5,871 km of on-effort trackline along the shelf break and offshore to the outer edge of the U.S. EEZ (NEFSC and SEFSC 2022). The second vessel survey covered waters from central Florida (25ºN latitude) to approximately 38ºN latitude between the 200-m isobaths and the outer edge of the U.S. EEZ during 12 June–31 August. A total of 5,659 km of trackline was covered on effort (NEFSC and SEFSC 2022). Both surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and Borchers 2004). Mark-recapture distance sampling was used to estimate abundance. Estimates from the two surveys were combined and CVs pooled to produce a species abundance estimate for the stock area.

Table 1. Summary of abundance estimates for Mesoplodon beaked whales (2016 surveys) and Gervais' beaked whales (2021 surveys), month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV). The estimate considered best is in bold font.

Month/Year	Area	N_{best}	CV
Jun–Sep 2016	Central Virginia to lower Bay of Fundy (*Mesoplodon* spp.)	6,760	0.37
Jun–Aug 2016	Central Florida to Virginia (*Mesoplodon* spp.)	3,347	0.29
Jun–Aug 2016	Central Florida to lower Bay of Fundy (COMBINED, *Mesoplodon* spp.)	10,107	0.27
Jun–Aug 2021	New Jersey to lower Bay of Fundy (*M. europaeus* only)	0	0
Jun–Aug 2021	Central Florida to New Jersey (*M. europaeus* only)	8,595	0.24
Jun–Aug 2021	**Central Florida to lower Bay of Fundy (COMBINED, *M. europaeus* only)**	**8,595**	**0.24**

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance of Gervais' beaked whales is 8,595 (CV=0.24). The minimum population estimate for Gervais' beaked whales in the western North Atlantic is 7,022.

Current Population Trend

A trend analysis has not been conducted for this stock. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval. 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). There is current work to standardize the strata-specific previous abundance estimates to consistently represent the same regions and include appropriate corrections for perception and availability bias. These standardized abundance estimates will be used in state-space trend models that incorporate environmental factors that could potentially influence the process and observational errors for each stratum.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. *Mesoplodon europaeus* life history parameters that could be used to estimate net productivity include: estimated mean length at birth of 2.1 m, length at sexual maturity of up to 5.2 m for females and up to 4.6 m for males, and maximum age of 27 dental growth layer groups (GLG's), which are presumed to each correspond to a single year of growth (Mead 1984).

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 minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for Gervais' beaked whales is 7,022 (Table 2). 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. PBR for Gervais' beaked whales in the western North Atlantic is 70.

Table 2. Best and minimum abundance estimates for Gervais' beaked whales (*Mesoplodon europaeus*) of the Western North Atlantic with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

N_{est}	CV N_{est}	N_{min}	F_r	R_{max}	PBR
8,595	0.24	7,022	0.5	0.04	70

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2017– 2021 total average estimated annual mortality of Gervais' beaked whales in observed fisheries in the U.S. Atlantic EEZ is zero. No information is available on average estimated annual mortality of Gervais' beaked whales from fisheries in Canadian waters.

Fishery Information

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

In 2017–2021, estimated annual average fishery-related mortality or serious injury of this stock in U.S. fisheries was 0 for all beaked whales. Detailed fishery information is reported in Appendix III.

Other Mortality

During 2017–2021, 18 Gervais' beaked whales stranded along the U.S. Atlantic coast (Table 3; NOAA National Marine Mammal Health and Stranding Response Database, accessed 15 October 2022).

Table 3. Gervais' beaked whale (*Mesoplodon europaeus*) strandings along the U.S. Atlantic coast.

State	2017	2018	2019	2020	2021	Total
North Carolina	2	8	1	4	0	15
South Carolina	0	0	0	1	0	1
Florida[a]	0	0	2	0	0	2
Total	**2**	**8**	**3**	**5**	**0**	**18**

a. Florida stranding in 2019 deemed human interaction due to plastic ingestion.

STATUS OF STOCK

Gervais' beaked whales are not listed as threatened or endangered under the Endangered Species Act and the western North Atlantic stock of Gervais' beaked whale is not considered strategic under the Marine Mammal Protection Act, although there are insufficient data to determine the population size or trends. The permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality, and no fishery-related mortality and serious injury has been observed during the recent 5-year (20173–202117) period. Therefore, the total U.S. fishery mortality and serious injury rate can be considered to be insignificant and approaching zero. The status of Gervais' beaked whales relative to OSP is unknown.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Habitat Issues

The chronic impacts of contaminants (polychlorinated biphenyls [PCBs] and chlorinated pesticides [DDT, DDE, dieldrin, etc.]) on marine mammal reproduction and health are of concern (e.g., Pierce et al. 2008; Jepson et al. 2016;

Hall et al. 2018; Murphy et al. 2018), but research on contaminant levels for the western north Atlantic beaked whales is lacking.

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). 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.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with naval activities (D'Amico et al. 2009; Filadelfo et al. 2009). During the mid- to late 1980's multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whale and Blainville's beaked whales occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 was associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998; A'Amico et al. 2009; Filadelfo et al. 2009). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001; NMFS 2001; Cox et al. 2006). Four Cuvier's, 2 Blainville's, and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsy of 6 dead beaked whales revealed evidence of tissue trauma associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (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).

Climate-related changes in spatial distribution and abundance, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Head et al. 2010; Pinsky et al. 2013; Poloczanska et al. 2013; Hare et al. 2016; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat/climatic factors. Results varied by season and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys during 2010 to 2017. There is uncertainty in how, if at all, the changes in distribution and population size of cetacean species may interact with changes in distribution of prey species and how the ecological shifts will affect human impacts to the species.

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