

CUVIER'S BEAKED WHALE (*Ziphius cavirostris*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of Cuvier's beaked whales is poorly known and is based mainly on stranding records (Leatherwood et al. 1976). Strandings have been reported from Nova Scotia along the eastern U.S. coast south to Florida, around the Gulf of Mexico, and within the Caribbean (Leatherwood et al. 1976; CETAP 1982; Heyning 1989; Houston 1990; MacLeod et al. 2006; Jefferson et al. 2008). Acoustic presence has been demonstrated from recordings collected from North Carolina to Nova Scotia, suggesting this species represents a transboundary stock (Stanistreet 2018).

Cuvier's beaked whale sightings have occurred principally along the continental shelf edge in the Mid-Atlantic region off the northeast U.S. coast (CETAP 1982; Waring et al. 1992; Waring et al. 2001; Hamazaki 2002; Palka 2006) (Figure 1). Monthly aerial surveys conducted off Cape Hatteras between 2011 and 2015 recorded Cuvier's beaked whales sighted during every month of the year (McLellan et al. 2018) and acoustic recordings confirm consistent year-round presence (Stanistreet et al. 2017).

Stock structure in the Western North Atlantic is unknown. A study of 20 Cuvier's beaked whales satellite-tagged offshore of Cape Hatteras, North Carolina, between 2014 and 2017 suggested that these animals have very restricted movements and could be a resident population (Foley 2018). Because the current stock spans multiple eco-regions (Longhurst 2007; Spalding et al. 2007), it is plausible that the stock could actually contain multiple demographically independent populations.

POPULATION SIZE

The best abundance estimate for Cuvier's beaked whales is the northeast 2021 survey described below—4,670 (CV=0.24). This estimate, derived from shipboard surveys, covers most of this stock's known range.

Recent Surveys and Abundance Estimates

Abundance estimates of 3,897 (CV=0.47) and 1,847 (CV=0.49) Cuvier's beaked whales (not including *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 38°N 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 38°N 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

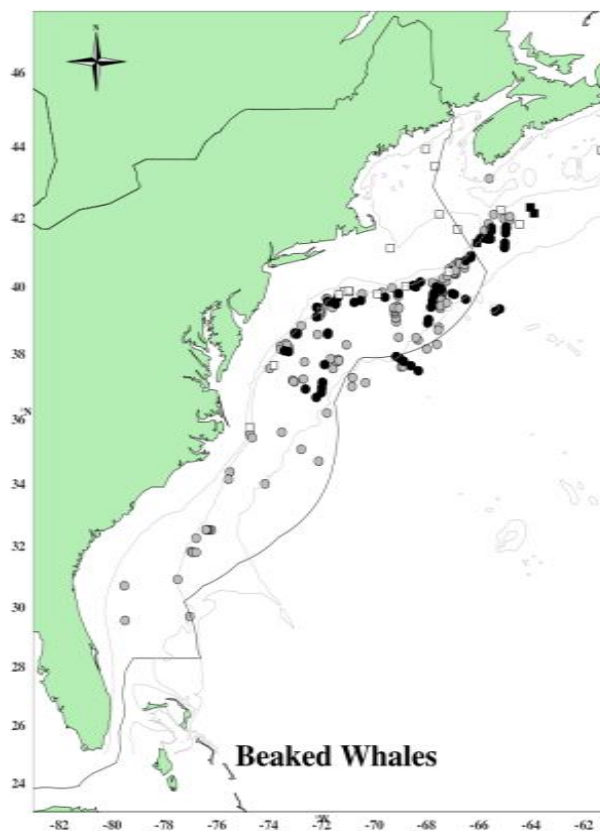


Figure 1. Distribution of beaked whale sightings (includes *Ziphius* and *Mesoplodon* spp.) from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, 2011 and 2016, 2021 and Department of Fisheries and Oceans Canada 2007 TNASS and 2016 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 Cuvier's beaked whales.

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 5,744 Cuvier’s beaked whales (CV=0.36). 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, and these numbers likely include an unknown number of Cuvier’s beaked whales.

More recent abundance estimates of 1,742 (CV=0.39) and 2,928 (CV=0.31) Cuvier’s beaked whale were generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2021 (Table 1; Garrison and Aichinger-Dias 2023; Palka 2023). One survey was conducted from 16 June to 23 August in waters north of 36°N 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 (25°N latitude) to approximately 38°N 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 the western North Atlantic stock of Cuvier’s beaked whales. 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 | 3,897 | 0.47 |
| Jun–Aug 2016 | Central Florida to Virginia | 1,847 | 0.49 |
| Jun–Aug 2016 | Central Florida to lower Bay of Fundy (COMBINED) | 5,744 | 0.36 |
| Jun–Aug 2021 | New Jersey to lower Bay of Fundy | 1,742 | 0.39 |
| Jun–Aug 2021 | Central Florida to New Jersey | 2,928 | 0.31 |
| Jun–Aug 2021 | Central Florida to lower Bay of Fundy (COMBINED) | 4,670 | 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 for Cuvier’s beaked whales is 4,670 (CV=0.24). The minimum population estimate for Cuvier’s beaked whales in the western North Atlantic is 3,817.

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. Life history parameters that could be used to estimate net productivity include: length at birth is 2 to 3 m, length at sexual maturity is 6.1m for females, and 5.5 m for males, maximum age expressed in dental growth layer groups (GLG’s) which are presumed to each correspond to a single year of growth is 30 for for females and 36 for males (Mitchell 1975; Mead 1984; Houston 1990).

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 Cuvier’s beaked whales is 3,817. 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 Cuvier’s beaked whales is 38.

Table 2. Best and minimum abundance estimates for the Western North Atlantic stock of Cuvier’s beaked whales with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) and PBR.

| Nest | CV | N _{min} | F _r | R _{max} | PBR |
|-------|------|------------------|----------------|------------------|-----|
| 4,670 | 0.24 | 3,817 | 0.5 | 0.04 | 38 |

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2017-2021 minimum annual rate of human-caused mortality of Cuvier’s beaked whales averaged 0.2 animals per year. This is from 1 stranding record that reported signs of human interaction (plastic ingestion; Table 3).

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 U.S. fishery information is reported in Appendix III.

Other Mortality

During 2017-2021, 4 Cuvier’s beaked whales stranded along the U.S. Atlantic coast without evidence of human interaction (Table 3; NOAA National Marine Mammal Health and Stranding Response Database, accessed 15 October 2022).

Table 3. Cuvier’s beaked whale (*Ziphius cavirostris*) strandings along the U.S. Atlantic coast from 2017-2021.

| State | 2017 | 2018 | 2019 | 2020 | 2021 | Total |
|----------------------|----------|----------|----------|----------|----------|----------|
| North Carolina | 1 | 0 | 0 | 0 | 0 | 1 |
| South Carolina | 0 | 0 | 0 | 1 | 0 | 1 |
| Florida ^a | 1 | 1 | 0 | 0 | 0 | 2 |
| Total | 2 | 1 | 0 | 1 | 0 | 4 |

a. Animal in Florida in 2018 had trash in stomach.

STATUS OF STOCK

The western North Atlantic stock of Cuvier’s beaked whale is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR. The total U.S. fishery mortality and serious injury for this group of species is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. The status of Cuvier’s beaked whale relative to OSP is unknown. This species is not listed as threatened or endangered under the Endangered Species Act.

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.

Several unusual mass strandings of beaked whales throughout their worldwide range have been associated with naval activities (Cox et al. 2006; D'Amico et al. 2009; Fernandez et al. 2005; Filadelfo et al. 2009). During the mid- to late 1980s 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 whale 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 were associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998; D'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. Necropsies 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).

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.

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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