

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). Stock structure in the North Atlantic is unknown.

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). Most sightings were in late spring or summer.

POPULATION SIZE

Estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) from selected regions are available for select time periods (Barlow *et al.* 2006) as well as two estimates of Cuvier's beaked whales alone. Survey platform type influences observer ability to identify species, with differentiation most difficult from aircraft, but observers have gained experience at distinguishing between species of beaked whales, enabling a single species estimate in some cases. Sightings are almost exclusively in the continental shelf edge and continental slope areas (Figure 1). The best abundance estimate for Cuvier's beaked whales is the sum of the 2011 surveys—6,532 (CV=0.32).

Earlier abundance estimates

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, and should not be used for PBR determinations. Further, Due to changes in survey methodology, these historical data should not be used to make comparisons to more current estimates.

Recent surveys and abundance estimates

An abundance estimate of 922 (CV=1.47) undifferentiated beaked whales (*Ziphius* and *Mesoplodon* spp.) was obtained from an aerial survey conducted in August 2006, which covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.).

An abundance estimate of 4,962 (CV=0.37) Cuvier's beaked whales (not including *Mesoplodon* spp.) was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour, through the U.S. and Canadian Gulf of Maine and up to and

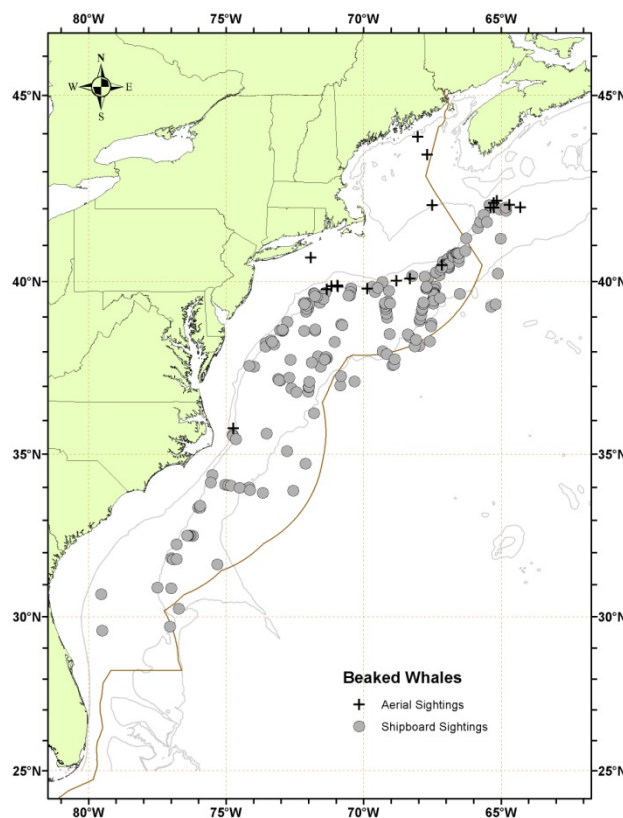


Figure 1. Distribution of beaked whale sightings (includes *Ziphius* and *Mesoplodon* spp.) from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006 and, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.

including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in water offshore of North Carolina to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a double-platform data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers, 2004). Shipboard data were inspected to determine if there was significant responsive movement to the ship (Palka and Hammond 2001). Because there was an insignificant amount of responsive movement for this species, the estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

An abundance estimate of 1,570 (CV=0.65) Cuvier’s beaked whales (not including *Mesoplodon* spp.) was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida. This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed two independent visual teams searching with 25× bigeye binoculars. A total of 4,445 km of tracklines were surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break with generally lower sighting rates over the continental slope. Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Although the 1990-2011 surveys did not sample exactly the same areas or encompass the entire beaked whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-2011 data suggest that, seasonally, at least several thousand beaked whales (undifferentiated) are occupying these waters, with highest levels of abundance in the Georges Bank region. NMFS surveys suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features (Waring *et al.* 2001; Hamazaki 2002).

Because the estimates presented here were not dive-time corrected, they are likely negatively biased and probably underestimate actual abundance. Given that beaked whales prefer deep-water habitats (Mead 1989) the bias may be substantial.

Table 1. Summary of abundance estimates for <i>Ziphius</i> ^a or the undifferentiated complex ^b of beaked whales which include <i>Ziphius</i> and <i>Mesoplodon</i> spp. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	Area	N_{best}	CV
Aug 2006 ^b	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	922	1.47
Jul-Aug 2011 ^a	central Virginia to lower Bay of Fundy	4,962	0.37
Jun-Aug 2011 ^a	central Virginia to central Florida	1,570	0.65
Jun-Aug 2011 ^a	Central Florida to lower Bay of Fundy (COMBINED)	6,532	0.32
a. 2011 estimates are for Cuvier’s beaked whales alone, not the undifferentiated complex.			
b. 2006 estimate includes <i>Mesoplodon</i> and <i>Ziphius</i> .			

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 (not including *Mesoplodon* spp.) is 6,532 (CV=0.32). The minimum population estimate for Cuvier’s beaked whales (not including *Mesoplodon* spp.) is 5,021.

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).

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 for females were 30 growth layer groups (GLG's) and for males was 36 GLG's, which may be annual layers (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 5,021. 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 50.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2007-2011 minimum annual rate of human-caused mortality of Cuvier's beaked whales averaged 0.4 animals per year. This is from two stranding records that showed signs of human interaction (1 fishery and 1 vessel strike) (Table 3).

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998; Andersen *et al.* 2008; NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

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.

Total annual estimated average fishery-related mortality or serious injury of this stock in 2007-2011 in U.S. observed fisheries was 0.2 due to one stranding record of a Cuvier's beaked whale with fishing net in its GI tract. Detailed fishery information is reported in Appendix III.

Earlier Interactions

There is no historical information available that documents incidental mortality of beaked whales in either U.S. or Canadian Atlantic coast fisheries (Read 1994). The only documented bycatch prior to 2003 of beaked whales is in the pelagic drift gillnet fishery (now prohibited). The bycatch only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October. Forty-six fishery-related beaked whale mortalities were observed between 1989 and 1998. These included 24 Sowerby's, 4 True's, 1 Cuvier's and 17 undifferentiated beaked whales. Recent analyses of biological samples (genetics and morphological analysis) have been used to determine species identifications for some of the bycaught animals. Estimated bycatch mortality by species is available for the 1994-1998 period. Prior estimates are for undifferentiated beaked whales. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.21), 76 in 1990 (0.26), 13 in 1991 (0.21), 9.7 in 1992 (0.24) and 12 in 1993 (0.16). The 1994-1998 estimates for Cuvier's beaked whales are 1 in 1994 (0.14) and zero for the years 1995-1996 and 1998. There was no fishery during 1997. During July 1996, one beaked whale was entangled and released alive with "gear in/around a single body part".

Pelagic Longline

One unidentified beaked whale was seriously injured in the U.S. Atlantic pelagic longline fishery in 2003. This interaction occurred in the Sargasso Sea fishing area. The estimated fishery-related combined mortality in 2003 was 5.3 beaked whales (CV=1.0). No serious injury or mortality interactions have been reported since 2003.

Other Mortality

During 2007-2011 nine Cuvier's beaked whales stranded along the U.S. Atlantic coast (Table 2). Two animals showed evidence of human interaction.

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).

State	2007	2008	2009	2010	2011	Total
New Jersey ^a	0	1	0	0	0	1
South Carolina ^b	1	0	0	0	0	1
Georgia	0	1	0	0	0	1
Florida	2	1	0	0	3	6
Total	3	3	0	0	3	9

a. Animal in New Jersey in 2008 had fishing net and a wood fragment found in the GI tract.
b. Animal in South Carolina in 2007 displayed signs of having been involved in a boat collision.

STATUS OF STOCK

Cuvier's beaked whales are not listed as threatened or endangered under the Endangered Species Act, and the western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. No habitat issues are known to be of concern for this species, but questions have been raised regarding potential effects of human-made sounds on deep-diving cetacean species such as Cuvier's beaked whales (Richardson *et al.* 1995). 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 in the U.S. Atlantic EEZ is unknown.

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