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 USA coast south to Florida, around the Gulf of Mexico, and within the Caribbean (Leatherwood *et al*. 1976; CETAP 1982; Heyning 1989; Houston 1990; Mignucci-Giannoni *et al.* 1999). 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continental shelf edge in the mid-Atlantic region off the northeast USA coast (CETAP 1982; Waring *et al*. 1992; NMFS unpublished data). Most sightings were in late spring or summer. Based on sighting data, this species is a rare inhabitant of waters off the northeast USA coast (CETAP 1982).

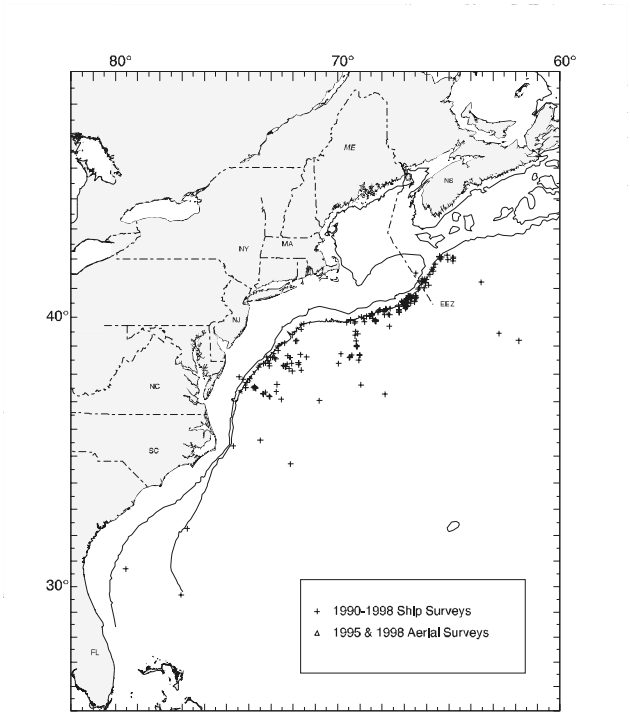

Figure 1. *Distribution of beaked whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1990-1998. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of Cuvier's beaked whales off the eastern USA Canadian Atlantic coast is unknown.

However, eight estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) from selected regions of the habitat do exist for select time periods. Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1). An abundance of 120 undifferentiated beaked whales (CV=0.71) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance of 442 (CV=0.51) undifferentiated beaked whales was estimated from an August 1990 shipboard line transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (Anon. 1990; Waring *et al.* 1992). An abundance of 262 (CV=0.99) undifferentiated beaked whales was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). An abundance of 370 (CV=0.65) and 612 (CV=0.73) undifferentiated beaked whales was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (Anon. 1991). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

An abundance of 330 (CV=0.66) undifferentiated beaked whales was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Anon.

1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school-size bias, if applicable, but do not include corrections for *g(0)* or dive-time. Variability was estimated using bootstrap resampling techniques.

An abundance of 99 (CV=0.64) undifferentiated beaked whales was estimated from an August 1994 shipboard line transect survey conducted within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank (Table 1; Anon. 1994). Data were collected by two alternating teams that searched with 25x150 binoculars and an independent observer who searched by naked eye from a separate platform on the bow. Data were analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school-size bias, if applicable, but do not include corrections for *g(0)* or dive-time. Variability was estimated using bootstrap resampling techniques.

An abundance of 1,519 (CV=0.69) undifferentiated beaked whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; Palka *et al.* in review). Total track line length was 32,600 km. The ships covered waters between the 50 and 1000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid-Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom depth contour line. Data collection and analysis methods used were described in Palka (1996).

An abundance of 2,600 (CV=0.40) undifferentiated beaked whales was estimated from a line transect sighting survey conducted during July 6 to September 6, 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38° N) (Figure 1; Palka *et al.* in review). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.

An abundance of 596 (CV=0.50) undifferentiated beaked whales was estimated from a shipboard line transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 5,570 km of track line in waters south of Maryland (38°N) (Figure 1; Mullin in review). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993) where school size bias and ship attraction were accounted for.

The best available abundance estimate for undifferentiated beaked whales is the sum of the estimates from the two 1998 USA Atlantic surveys, 3,196 (CV=0.34), where the estimate from the northern USA Atlantic is 2,600 (CV=0.40) and from the southern USA Atlantic is 596 (CV=0.50). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

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

Table 1. Summary of abundance estimates for the undifferentiated complex of beaked whales which include *Ziphius* and *Mesoplodon* 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 1994	warm-core ring SE of Georges Bank	99	0.64
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	1,519	0.69
Jul-Sep 1998	Maryland to Gulf of St. Lawrence	2,600	0.40
Jul-Aug 1998	Florida to Maryland	596	0.50
Jul-Sep 1998	Gulf of St. Lawrence to Florida (COMBINED)	3,196	0.34

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 undifferentiated beaked whales is

3,196 (CV=0.34). The minimum population estimate for the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 2,419 (CV=0.34). It is not possible to determine the minimum population estimate of only Cuvier's beaked whales.

Current Population Trend

There are insufficient data to determine the population trends for this species.

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 6.1 m 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 the undifferentiated complex of beaked whales is 2,419 (CV=0.34). 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 this stock is of unknown status. PBR for all species in the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 24. It is not possible to determine the PBR for only Cuvier's beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 1996-2000 total average estimated annual fishery-related mortality of beaked whales in open fisheries in the US Atlantic EEZ was zero.

Fishery Information

There is no historical information available that documents incidental mortality in either USA or Canadian Atlantic coast fisheries (Read 1994).

Current data on incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993 the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and currently provides observer coverage of vessels fishing south of Cape Hatteras.

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 US Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

Bycatch has been observed by NMFS Sea Samplers in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in the pelagic longline, pelagic pair trawl, Northeast multispecies sink gillnet, mid-Atlantic coastal gillnet, or North Atlantic bottom trawl fisheries by NMFS Sea Samplers.

Pelagic Drift Gillnet

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995,1996, and 1998 were 233, 243, 232, 197, 164, 143, and 113 respectively. In 1996 and 1997, NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 NMFS issued a Final Rule to prohibit the use of driftnets (*i.e.*, permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. From 1994 - 1998, between 10 and 13 vessels have participated in the fishery.

Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, 64% in 1996, and 99% in 1998. Effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year, suggested that the pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total bycatch, for each year from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual bycatch for 1994 - 1998 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. Bycatch of beaked whales has 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 analysis of biological samples (genetics and morphological analysis) have been used to determine species identifications for some of the by-caught animals. Estimation of by-catch mortalities by species are 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 by 'species' are:

Year	Cuvier's	Sowerby's	True's	*Mesoplodon* spp.
1994	1 (0.14)	3 (0.09)	0	0
1995	0	6 (0)	1 (0)	3 (0)
1996	0	9 (0.12)	2 (0.26)	2 (0.25)
1997	NA	NA	NA	NA
1998	0	2 (0)	2 (0)	7 (0)

During July 1996, one beaked whale was entangled and released alive with "gear in/around a single body part". Annual mortality estimates do not include any animals injured and released alive.

Other Mortality

From 1992- to 2000, a total of 53 beaked whales stranded along the USA Atlantic coast between Florida and Massachusetts (NMFS unpublished data). This includes: 28 (includes one tentative identification) Gervais' beaked whales (one 1997 animal had plastics in esophagus and stomach, and Sargassum in esophagus; 2 animals that stranded in September 1998 in South Carolina showed signs of fishery interactions); 2 True's beaked whales; 5 Blainville's beaked whales; 1 Sowerby's beaked whales; 13 Cuvier's beaked whales (one 1996 animal had propeller marks, and one 2000 animal had a longline hook in the lower jaw) and 4 unidentified animals.

Also, several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with naval activities. 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 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). 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; Anon. 2002). 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. 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) (Anon. 2002).

STATUS OF STOCK

The status of Cuvier's beaked whale relative to OSP in US Atlantic EEZ is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. Although a species specific PBR cannot be determined, the permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality. The total fishery mortality and serious injury for this group is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because of uncertainty regarding stock size and evidence of human induced mortality and serious injury associated with acoustic activities.

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