BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Western North Atlantic Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two distinct bottlenose dolphin ecotypes (Duffield et al. 1983; Duffield 1986; Mead and Potter 1995; Walker *et al*. in press) which correspond to a shallow, warm water ecotype and a deep, cold water ecotype; both ecotypes have been shown to inhabit waters in the western North Atlantic Ocean (Hersh and Duffield 1990; Mead and Potter 1995; Walker *et al*. in press). Bottlenose dolphins which had stranded alive in the western North Atlantic in areas with direct access to deep oceanic waters had hemoglobin profiles matching that of the deep, cold water ecotype (Hersh and Duffield 1990). Hersh and Duffield (1990) also described morphological differences between the deep, cold water ecotype dolphins and dolphins with hematological profiles matching the shallow, warm water ecotype which had stranded in the Indian/Banana River in Florida. Because of their occurrence in shallow, relatively warm waters along the U.S. Atlantic coast and because their morphological characteristics are similar to the shallow, warm water ecotype described by Hersh and Duffield (1990), the Atlantic coastal bottlenose dolphin stock is believed to consist of this ecotype. There are currently insufficient data to allow separation of locally resident bottlenose dolphins (such as those from the Indian/Banana River) from the coastal stock in the western North Atlantic.

The structure of the coastal bottlenose dolphin stock in the western North Atlantic is uncertain, but what is known about it suggests that the structure is complex. A portion of the coastal stock migrates north of Cape Hatteras, North Carolina, to New Jersey during the summer (Scott et al. 1988). It has been suggested that this stock is restricted to waters < 25 m in depth within the northern portion of its range (Kenney 1990) because of an apparent disjunct distribution of bottlenose dolphins centered on the 25 m isobath which was observed during surveys of the region (CeTAP 1980). The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. The coastal stock is believed to reside south of Cape Hatteras in the late winter (Mead 1975; Kenney 1990); however, the depth distribution of the stock south of Cape Hatteras is uncertain and the coastal and offshore stocks may overlap there. There was no apparent longitudinal discontinuity in bottlenose dolphin herd sightings during aerial surveys south of Cape Hatteras in the winter (Blaylock and Hoggard 1994).

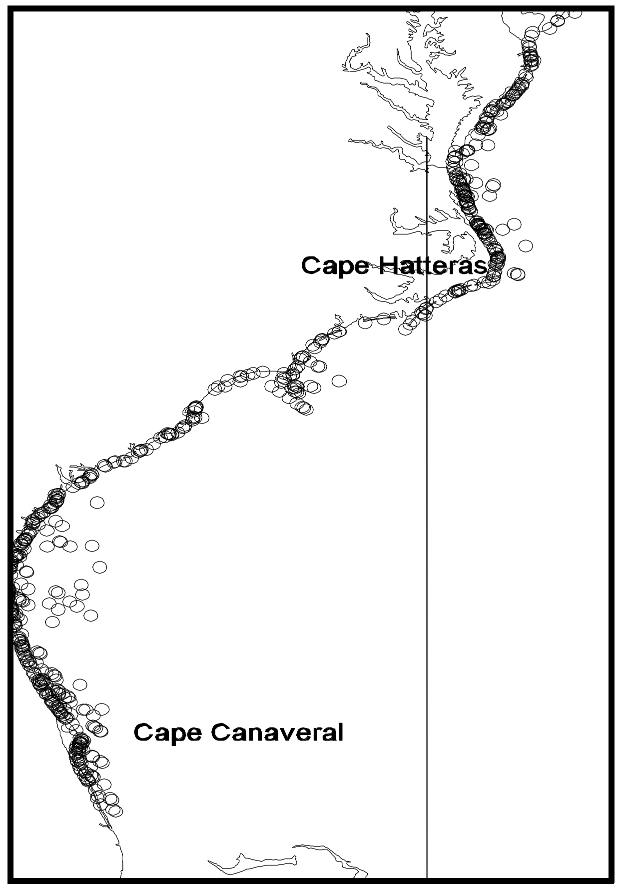

Figure 1. *Sightings of bottlenose dolphins during aerial surveys to the 25 m isobath north of Cape Hatteras during summer 1994, 9 km past the eastern Gulf Stream wall south of Cape Hatteras during winter 1991, and three coastal surveys within one km of shore from New Jersey to mid-Florida during the summer in 1994.*

Scott et al. (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, NY, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-88 and observed density patterns along the U.S. Atlantic coast. Figure 1 illustrates the distribution of 584 bottlenose dolphin herd sightings during aerial surveys from shore to approximately 9 km past the Gulf Stream edge south of Cape Hatteras in the winter in 1992 (Blaylock and Hoggard 1994), from shore seaward to the 25 m isobath during the summer north of Cape Hatteras in 1994 (Blaylock 1995), and within one km of the shore from New Jersey to mid-Florida during three coastal surveys conducted during the summer in 1994 (Blaylock 1995). The proportion of the sightings illustrated which might be of bottlenose dolphins from other than the coastal stock is unknown; however, it is reasonable to assume that the coastal surveys within one km of shore minimized inclusion of the offshore stock.

A working hypothesis for the coastal bottlenose dolphin stock structure postulates that there are local, resident stocks in certain embayments and that transient stocks migrate seasonally into and out of these embayments (Scott et al. 1988). In the Indian-Banana River, 28 of 36 marked bottlenose dolphins either resided in or returned to the river system for a period of at least ten years (Odell and Asper 1990). Eight of the marked dolphins were never positively resighted. None of the marked dolphins were reported from outside the river system; however, search outside of the river system was limited. If the working hypothesis is correct, exchange between resident and transient components of the coastal stock could be sufficient to mask any genetic indicators of stock distinction, even though the stock components might be sufficiently distinct to respond differently to population pressures. Additional, recent information, suggests that more than one stock does exist along the mid-Atlantic coast (summarized in Hohn 1997).

POPULATION SIZE

Mitchell (1975) estimated that the coastal bottlenose dolphin population which was exploited by a shore-based net fishery until 1925 (Mead 1975) was at least 13,748 bottlenose dolphins in the 1800s. Recent estimates of bottlenose dolphin abundance in the U.S. Atlantic coastal area were made from two types of aerial surveys. The first type was aerial survey using standard line transect sampling with perpendicular distance data analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993). The alternate survey method consisted of a simple count of all bottlenose dolphins seen from aerial surveys within one km of shore.

An aerial line-transect survey was conducted during February-March 1991 in the coastal area south of Cape Hatteras. Sampling transects extended orthogonally from shore out to approximately 9 km past the western wall of the Gulf Stream into waters as deep as 140 m, and the area surveyed extended from Cape Hatteras to mid-Florida (Blaylock and Hoggard 1994). Systematic transects were placed randomly with respect to bottlenose dolphin distribution and approximately 3.3% of the total survey area of approximately 89,900 km^2 was visually searched. Survey transects, area, and dates were chosen utilizing the known winter distribution of the stocks in order to sample the entire coastal population; however, the offshore stock may represent some unknown proportion of the resulting population size estimates. Preliminary estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to the perpendicular distance sighting data. Bottlenose dolphin abundance was estimated to be 12,435 dolphins with coefficient of variation (CV) = 0.18 and the log-normal 95% confidence interval was 9,684-15,967 (Blaylock and Hoggard 1994). An aerial survey was conducted during late January-early March 1995, following nearly the same design as the 1991 survey. Preliminary analysis (following the same procedures described above) resulted in an abundance estimate of 21,128 dolphins (CV = 0.22) with a long-normal 95% confidence interval of 13,815-32,312.

Perpendicular sighting distance analysis (Buckland et al. 1983) of line transect data from an aerial survey throughout the northern portion of the range in July 1994, from Cape Hatteras to Sandy Hook, New Jersey, and from shore to the 25 m isobath, resulted in an abundance estimate of 25,841 bottlenose dolphins (CV = 0.40) (Blaylock 1995) within the approximately 25,600 km^2 area. These data were collected during a pilot study for designing future surveys and are considered to be preliminary in nature. An aerial survey of this area was conducted during mid July-mid August 1995. Data from the pilot study was used to design this survey; survey sampling was designed to produce an abundance estimate with a CV of 0.20 or less. Preliminary analysis (following the same procedures described above for the surveys south of Cape Hatteras) resulted in an abundance estimate of 12,570 dolphins (CV = 0.19) with a log-normal 95% confidence interval of 8,695-18,173.

Either of the aerial line transect surveys and the resulting abundance estimates may have included dolphins from the offshore stock. It is not currently possible to distinguish the two bottlenose dolphin ecotypes during visual aerial surveys and the distribution of the two ecotypes in U.S. Atlantic EEZ waters is uncertain. Additional research is needed to interpret the significance of the line transect survey results.

An aerial survey of the coastal waters within a one km strip along the shore from Sandy Hook to approximately Vero Beach, Florida, was also conducted during July 1994 (Blaylock 1995). Dolphins from the offshore stock are believed unlikely to occur in this area. Observers counted all bottlenose dolphins seen within the one km strip alongshore from

Cape Hatteras to Sandy Hook (northern area) and within the one km strip alongshore south of Cape Hatteras to approximately Vero Beach (southern area). The average of three counts of bottlenose dolphins in the northern area was 927 dolphins (range = 303-1,667) and the average of three counts of bottlenose dolphins in the southern area was 630 dolphins (range = 497-815). The sum of the highest counts in both areas was 2,482 dolphins.

Minimum Population Estimate

Reasonable assurance of a minimum population estimate was not provided by line transect surveys because the proportion of dolphins from the offshore stock which might have been observed is unknown. The minimum population size was therefore taken as the highest count of bottlenose dolphins within the one km strip from shore between Sandy Hook and Vero Beach obtained during the July 1994 survey. The maximum count within one km of shore between Sandy Hook and Cape Hatteras was 1,667 bottlenose dolphins and it was 815 bottlenose dolphins within one km of shore between Cape Hatteras and Vero Beach. The resulting minimum population size estimate for the western North Atlantic coastal bottlenose dolphin stock is 2,482 dolphins.

Current Population Trend

Kenney (1990) reported an estimated 400-700 bottlenose dolphins from the inshore strata of aerial surveys conducted along the U.S. Atlantic coast north of Cape Hatteras in the summer during 1979-1981. These estimates resulted from line transect analyses; thus, they cannot be used in comparison with the direct count data collected in 1994 to assess population trends.

There was no significant difference in bottlenose dolphin abundance estimated from aerial line transect surveys conducted south of Cape Hatteras in the winter of 1983 and the winter of 1991 using comparable survey designs (NMFS unpublished data; Blaylock and Hoggard 1994) in spite of the 1987-88 mortality incident during which it was estimated that the coastal migratory population may have been reduced by up to 53% (Scott et al. 1988).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 productivity rate, and a “recovery” factor (Wade and Angliss 1997). The “recovery “ factor, which accounts for endangered, depleted, and threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.50 because this stock is listed as depleted under the Marine Mammal Protection Act. PBR for the U.S. Atlantic coastal bottlenose dolphin stock is 25 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

From 1992-1995, one hundred and eighty-nine bottlenose dolphins stranded in waters north of Cape Hatteras (Virginia to Massachusetts) (NMFS, unpublished data). The majority of the strandings within this northern area occurred in Virginia (n = 116, 61%). An unknown number (analysis underway) of these animals have shown signs of entanglement with fishing gear or interactions with fishing activities. In 1993, eight bottlenose dolphins in Virginia and one in Maryland were reported as entangled in fishing gear, but the gear type was not reported (NMFS unpublished data). Signs of interaction with fisheries (entanglement, net marks, missing appendages) were present in 22% of the bottlenose dolphin strandings investigated in North Carolina in 1993 (NMFS unpublished data). In 1994, 1995, and 1 January-August 31, 1996, one hundred and ninety-two, 196, and 154, respectively, strandings were reported in the NMFS southeast region (Florida to North Carolina) (NMFS, unpublished data). In 1994, 24 (12%) showed signs of human interaction, 14 (7% of total strandings) had evidence of entanglement with fishing gear. In 1995, 23 (12%) showed signs of human interaction, 12 (6%) cases had evidence of entanglement with fishing gear. Southeast U.S. Marine mammal stranding records indicated that from 1988-1995 an average of 22 bottlenose dolphins showed signs of human interaction (net marks, entanglement, mutilations, boat strikes, gunshot wounds) annually.

North Carolina stranding records show the highest incidence of fishery interactions from the SE Atlantic Region. North Carolina data from 1993 through 1996 have been examined to better determine the annual percentages of human interaction. Due to the extent of decomposition and/or the level of experience of the examiner, a determination cannot always be made as to whether or not a stranding occurred due to human interaction. Of the 230 bottlenose dolphin strandings reported in North Carolina from 1993 to 1996, evidence of fisheries interactions was documented in 67 cases (42% of those cases for which a human interaction determination could be made). In addition, other types of human interaction (*i.e.*: prop cuts, gun shots, etc.) were documented in 17 instances (11% of the total number of cases in which a determination was made) (NMFS, unpublished data).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. In addition, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fishery Information

Menhaden purse seiners have reported an annual incidental take of one to five bottlenose dolphins (NMFS 1991, pp. 5-73). Observer data are not available. The Atlantic menhaden purse seine fishery targets the Atlantic menhaden, *Brevortia tyrannus*, in Atlantic coastal waters approximately 3-18 m in depth. Twenty-two vessels operate off northern Florida to New England from April-January (NMFS 1991, pp. 5-73).

Coastal gillnets operate in different seasons targeting different species in different states throughout the range of this stock. Most nets are staked close to shore, but some are allowed to drift, and nets range in length from 91 m to 914 m. A gillnet fishery for American shad, *Alosa sapidissima*, operates seasonally from Connecticut to Georgia, with nets being moved from coastal ocean waters into fresh water with the shad spawning migration (Read 1994). It is considered likely that a few bottlenose dolphins are taken in this fishery each year (Read 1994). The portion of the fishery which operates along the South Carolina coast was sampled by observers during 1994 and 1995, and no fishery interactions were observed (McFee *et al*. 1996). The North Carolina sink gillnet fishery operates in October-May targeting weakfish, croaker, spot, bluefish, and dogfish. Another gillnet fishery along the North Carolina Outer Banks targets bluefish in January-March. Similar mixed-species gillnet fisheries, under state jurisdiction, operate seasonally along the coast from Florida to New Jersey, with the exclusion of Georgia. There are no estimates of bottlenose dolphin mortality or serious injury available for these fisheries. A rough estimate of the average total annual coastal gillnet fishing effort is given in Table I.

Observer coverage of the U.S. Atlantic coastal gillnet fisheries for monkfish and dogfish, primarily, was initiated by the NEFSC Sea Sampling program in July, 1993. From July to December 1993, 20 trips were observed. By 1996, 350 trips were observer, representing about less than 5% coverage. This coastal gillnet fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records are held by both state and federal agencies, and have not, as of yet, been centralized and standardized. Still, only one bottlenose dolphins has been taken in the observed trips, despite large numbers of stranded dolphins with signs of fishery interactions. Hence, this observer program is not covering those components of the coastal gillnet complex responsible for most of the interactions with coastal bottlenose dolphins.

The shrimp trawl fishery operates from North Carolina through northern Florida virtually year around, moving seasonally up and down the coast. Estimated total fishing effort is given in Table I. One bottlenose dolphin was recovered dead from a shrimp trawl in Georgia in 1995 (Southeast U.S. Marine Mammal Stranding Network unpublished data), but no bottlenose dolphin mortality or serious injury has been previously reported to NMFS.

Table I. *Roughly estimated average annual fishing effort (number deployed) by gear type for U.S. Atlantic coastal fisheries from New Jersey to Key West, Florida, in 1992-1993, having the potential for causing serious injury or mortality to bottlenose dolphins (NMFS unpublished data).*

Gear Type	Effort
Haul seines	222
Purse seines	11,962
Otter trawls, bottom	22,550
Otter trawls, midwater	70

A haul seine fishery operates along northern North Carolina beaches during the spring and fall targeting mullet, spot, sea trout, and bluefish. There has been no by-catch of marine mammals reported to NMFS.

Other Mortality

The nearshore habitat occupied by this stock is adjacent to areas of high human population and in the northern portion of its range is highly industrialized. The blubber of stranded dolphins examined during the 1987-88 mortality event contained anthropogenic contaminants in levels among the highest recorded for a cetacean (Geraci 1989). There are no estimates of indirect human-caused mortality resulting from pollution or habitat degradation, but a recent assessment of the health of live-captured bottlenose dolphins from Matagorda Bay, Texas, associated high levels of certain chlorinated hydrocarbons with low health assessment scores (Reif et al., in review).

STATUS OF STOCK

This stock is considered to be depleted relative to OSP and it is listed as depleted under the Marine Mammal Protection Act (MMPA). There are data suggesting that the population was at an historically high level immediately prior to the 1987-88 mortality event (Keinath and Musick 1988); however, the 1987-88 anomalous mortality event was estimated to have decreased the population by as much as 53% (Scott et al. 1988). A comparison of historical and recent winter aerial survey data in the area south of Cape Hatteras found no statistically significant difference between population size estimates (Student's t-test, $P > 0.10$), but these estimates may have included an unknown proportion of the offshore stock Population trends cannot be determined due to insufficient data.

There are limited observer data directly linking serious injury and mortality to fisheries (e.g., in the stop net fishery in North Carolina), but the total number of bottlenose dolphins assumed from this stock which stranded showing signs of fishery or human-related mortality exceeded PBR in 1993 and again by mid-1997. In North Carolina alone, human-related mortality approached PBR in each of the intervening years. The total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR, and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate.

The species is not listed as threatened or endangered under the Endangered Species Act, but because this stock is listed as depleted under the MMPA it is a strategic stock.

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