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BOTTLENOSE DOLPHIN (*Tursiops truncatus*)
Northern North Carolina Estuarine System Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present primarily in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several areas (Caldwell 2001; Gubbins 2002; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Balmer *et al.* 2008). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005).

The Northern North Carolina Estuarine System (NNCES) stock is bounded in the south by the Beaufort Inlet and in the north by the border between North Carolina and Virginia, and encompasses all estuarine waters in between, including but not limited to the Intracoastal Waterway, Pamlico, Albemarle and Currituck Sounds, and tributaries. The borders are delineated primarily on the basis of available estuarine habitat and telemetry data (NMFS unpublished data) suggesting a break in movement of bottlenose dolphins north and south of the Beaufort Inlet area. Borders are subject to change upon further study of dolphin residency patterns in estuarine waters of Virginia, North Carolina and northern South Carolina. Estuarine animals residing within the NNCES were previously included in stock assessment reports for the Western North Atlantic Coastal Morphotype Stocks of bottlenose dolphins (e.g., Waring *et al.* 2007).

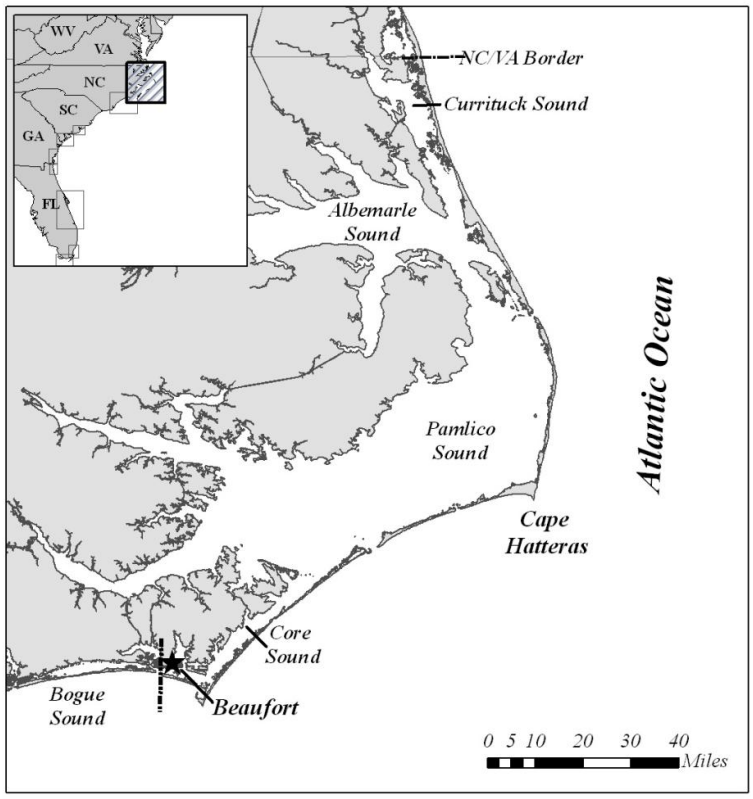

Figure 1. *Geographic extent of the Northern North Carolina Estuarine System (NNCES) stock, located on the coast of North Carolina. The borders are denoted by dashed lines.*

This stock has been defined as an estuarine stock primarily by the results of telemetry-based studies of movement patterns and photo-ID studies. Animals captured and released near Beaufort, North Carolina, were fitted with satellite-linked transmitters during November 1999 (3 animals), April 2000 (8 animals), and April 2006 (5 animals) (NMFS unpublished data). The information provided by photo-ID studies also supports the defined stock boundaries (Urian *et al.* 1999; Read *et al.* 2003; Urian, pers. comm.; NMFS unpublished data).

The locations derived from the telemetry studies revealed that most of the dolphins captured and released near Beaufort, North Carolina, displayed movements characteristic of estuarine animals; most or all of the locations in the spring and summer were within estuaries with the majority of locations in Pamlico Sound or its tributaries. Two of the animals exhibited locations during the winter that were characteristic of coastal animals, occurring primarily within 1 km of the ocean-front beaches between Cape Hatteras and about 35 km southwest of the western end of

Bogue Sound; however, there may be seasonal patterns in the spatial distribution of the estuarine stock. Photo-ID studies indicate that during the winter known estuarine animals occur along the ocean-front beaches possibly more frequently than during the spring and summer (Urian, pers. comm.). The duration of the Beaufort tag attachments averaged about 70 days (n=16, σ=46.3, range=25 to 173). Taken as a whole, these data infer that there may be a resident estuarine stock that occupies the estuarine waters from in and around Beaufort north to the Virginia border. Interestingly, the movement patterns of these estuarine animals were similar to those shown by resights of individual dolphins during a photo-ID study that sampled much of the estuarine waters of North Carolina (Read *et al.* 2003). Read *et al.* (2003) suggested that, based on these patterns, differences in group sizes, and habitat, there may be a northern stock and southern stock in North Carolina estuarine waters, with the stock boundary near Beaufort, North Carolina.

Photo-ID studies have shown that some animals move between the estuaries in and around Beaufort south to the southern end of the boundary of the Southern North Carolina Estuarine System stock, and some move from Beaufort north into Pamlico Sound and adjacent waters (Urian *et al.* 1999; Urian, pers. comm.; NMFS unpublished data), and telemetry data showed that animals moved between Beaufort and Pamlico Sound. This overlap near the Beaufort area could suggest that there is only 1 stock that includes estuarine waters from the North Carolina/South Carolina border to the North Carolina/Virginia border. However, few animals have been observed to occur both south and north of the Beaufort area; therefore, the estuarine animals are defined as 2 stocks. The available information does not provide consistent, year-round coverage so it is possible that there may be seasonal variability in distribution patterns that may conflict with this stock definition. The telemetry studies and the photo-ID studies show that while the preponderance of locations where animals of the NNCES stock have been observed was in estuarine waters, at least some of the animals do occur in coastal waters. A variety of existing datasets with information on spatial distribution patterns of this stock may be useful for accurately quantifying its usage of coastal waters, and the integration and analyses of those data have been initiated. Information on use of coastal waters will be important when considering exposure to coastal fisheries as estuarine animals that make use of nearshore coastal waters would be at risk of entanglement in fishing gear while moving along the coast.

POPULATION SIZE

Population size estimates for this stock are greater than 8 years old and therefore the current population size for the stock is considered unknown (Wade and Angliss 1997). Read *et al.* (2003) provided the first and only available abundance estimate of bottlenose dolphins that occur within the proposed boundaries of the NNCES stock. This estimate is based on a photo-ID mark-recapture survey of a portion of North Carolina waters inshore of the barrier islands, conducted during July 2000. Because the survey did not sample all the estuarine waters where dolphins are known to occur, the estimates of abundance may be negatively biased. Read *et al.* (2003) estimated the number of animals in the inshore waters of North Carolina equivalent to that of the NNCES stock to be 919 (95% CI 730 - 1,190, CV=0.13). Gubbins *et al.* (2003) also conducted a photo-ID mark-recapture study and provided an abundance estimate (513, CV=0.13) for inshore and nearshore waters near Beaufort, North Carolina, but this area represented only a small portion of the NNCES stock area and included animals in coastal waters. Goodman *et al.* (2007) conducted seasonal, strip-transect aerial surveys of southwestern Pamlico Sound from July 2004 through April 2006. Their survey area sampled approximately 25% or less of the waters within the NNCES stock boundaries. Mean seasonal abundance estimates ranged from a low of 54 (CV=0.46) during June - August 2005 (summer), to a high of 426 (CV=0.35) during September - November 2004 (autumn), but seasonal patterns were not consistent among years. For example, the estimate for spring of 2005 was only 71 (CV=0.39) while the estimate for spring of 2006 was 323 (CV=0.35).

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 20^{th} percentile of the log-normal distribution as specified by Wade and Angliss (1997). Because the only available comprehensive abundance for this stock (from Read *et al.* 2003) was derived from data that are more than 8 years old, they may not be used to calculate the minimum population estimate, and as a result the minimum population estimate for the NNCES stock of bottlenose dolphins is unknown. The lowest seasonal estimate provided by Goodman *et al.* (2007) could be used, but that estimate is for 25% or less of the stock's range and is likely unrealistically low. The large variation in the Goodman *et al.* (2007) estimates could indicate that the sampling methodology was inappropriate for estimating abundance or that the movements of animals within the stock's range, both into and out of the sampling area, resulted in the variation. A new estimate of abundance based on photo-ID mark-recapture studies will be forthcoming (Read, pers. comm.).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown 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 (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the NNCES stock of bottlenose dolphins is unknown. 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 this stock of bottlenose dolphins is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for this stock during 2003-2007 is unknown.

Fishery Information

The NNCES stock interacts with 3 Category II fisheries: the Atlantic blue crab trap/pot fishery, North Carolina long haul seine fishery, and North Carolina inshore gillnet fishery. There is no systematic observer coverage of these fisheries by the National Marine Fisheries Service (NMFS), although the North Carolina Division of Marine Fisheries operates systematic coverage of the fall flounder gillnet fishery in Pamlico Sound (Price 2008). As a result, information about interactions with North Carolina inshore fisheries is based solely on stranding data and it is not possible to estimate the annual number of interactions or mortalities in these fisheries. The NNCES stock may also interact with the mid-Atlantic gillnet fishery and mid-Atlantic haul/beach seine fishery, but estimates of the potential for these interactions will not be known until the various datasets on spatial distribution mentioned above are integrated and analyzed.

From 2003 through 2007, 64 bottlenose dolphins were found stranded or entangled in gear within the NNCES area (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). Of these, it was possible to determine whether or not a human interaction (HI; e.g., gear and debris entanglement, mutilation, boat collision) had occurred for 15 (23.4%); for the remainder it was not possible to make that determination due primarily to decomposition. Eleven of the 15 strandings were categorized as 'yes' for evidence of HI, 9 of which were determined to have been involved in a fisheries interaction (FI) based on direct observation of entanglement or by entanglement lesions (Read and Murray 2000). For 2 HI strandings, it could not be determined if they were fishery interactions or not; 1 of the 2 was mutilated, but was too decomposed to classify as yes or no for FI. The other animal had line tied around the peduncle that was inconsistent with fishing line and similar to "parachute cord". This animal was also too decomposed to determine the presence or absence of entanglement lesions consistent with fishing gear.

Of the FI strandings (n=9), 2 were actually removed from gear. One animal was found dead and entangled in lines attached to 2 crab pots. Another animal was recovered dead and entangled in the lead of a pound net. The other 7 FI strandings had entanglement lesions most consistent with entanglement in monofilament gillnet webbing. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fishery interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 1. Bottlenose dolphin strandings for the Northern North Carolina Estuarine System (NNCES) stock from 2003 to 2007, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (accessed 10 November 2008). Please note human interaction does not necessarily mean the interaction caused the animal's death.

Stock	Category	2003	2004	2005	2006	2007	Total
Northern NCES	Total Stranded	12	12	6	14	20	64
	Human Interaction	3	3	0	3	2	11
	No Human Interaction	1	1	0	2	0	4
	CBD	8	8	6	9	18	49

Other Mortality

In June 2007, a dead bottlenose dolphin was found in a research beach seine set in Corolla, North Carolina. This was a one-time study to compare the catch size and composition between 2 different types of beach anchored gear using small mesh webbing (3-inch stretched mesh): (1) the "traditional" beach seine that uses all multifilament (twisted nylon) webbing with different twine sizes used in the wings and the bunt, and (2) the beach-anchored gillnet that uses a combination of monofilament wings and multifilament/twisted nylon bunt. The dolphin was found dead in the net constructed of all multifilament webbing. Additionally, in July 2007, a dead bottlenose dolphin was found in a research gillnet set in the Neuse River, a large tributary in southwestern Pamlico Sound. This research sampling has occurred from February 15 through December 15 each year since 1999, and this is the first entanglement that is known to have occurred.

Three bottlenose dolphins that were captured, tagged with satellite-linked transmitters, and released near Beaufort, North Carolina, during April 2006 by the NMFS as part of a long-term stock delineation research project were believed to have died shortly thereafter as a result of the capture or tagging (NMFS unpublished data). Two of the animals were recovered stranded but because of advanced decomposition of the carcasses cause of death could not be determined. One of these 2 animals was known from long-term photo-ID and was likely of the Southern North Carolina Estuarine System stock. The third animal has not been observed subsequent to release, but patterns in the data received from its satellite tag were similar to that of the other 2 and indicated the fates were similar. These last 2 animals were, based on satellite-derived locations, likely of the NNCES stock.

This stock inhabits areas with significant drainage from agricultural, industrial and urban sources, and as such is exposed to contaminants in runoff from those sources. The blubber of 47 bottlenose dolphins captured and released in and around Beaufort contained contaminant levels of some level, and 7 had unusually high levels of the pesticide methoxychlor (Hansen *et al.* 2004). While there are no estimates of indirect human-caused mortality from pollution or habitat degradation, Schwacke *et al.* (2002) found that the levels of polychlorinated biphenyls (PCBs) observed in Beaufort female bottlenose dolphins would likely impair reproductive success, especially of primiparous females.

STATUS OF STOCK

From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the western North Atlantic, and the entire stock was listed as depleted as a result of the 1987-1988 mortality event. Scott *et al.* (1988) suggested that dolphins residing in the bays, sounds and estuaries adjacent to these coastal waters were not affected by the mortality event and these animals were explicitly excluded from the depleted listing (Federal Register: 54(195), 41654-41657; 56(158), 40594-40596; 58(64), 17789-17791).

The status of the NNCES stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. However, considering the evidence from stranding data (Table 1), the total human-caused mortality and serious injury is likely not insignificant, and, therefore, the levels are likely not approaching zero mortality and serious injury rate. Because the stock size is currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

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