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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Geographic Range and Coastal Morphotype Habitat

In the western North Atlantic, the coastal morphotype of common bottlenose dolphins is continuously distributed in nearshore coastal and estuarine waters along the U.S. Atlantic coast south of Long Island, New York, around the Florida peninsula and into the Gulf of Mexico. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Duffield and Wells 2002; Rosel *et al.* 2009). The coastal morphotype is morphologically and genetically distinct from the larger, more robust morphotype that occupies habitats further offshore in the western North Atlantic and Gulf of Mexico (Mead and Potter 1995; Hoelzel *et al.* 1998; Rosel *et al.* 2009; Vollmer 2011). Aerial surveys conducted between 1978 and 1982 (Kenney 1990) north of Cape Hatteras, North Carolina, identified two concentrations of bottlenose dolphins, one near the coast within the 25-m isobath and the other further offshore concentrated at the continental shelf edge. The lowest density of bottlenose dolphins was observed over the continental shelf. It was suggested, therefore, that north of Cape Hatteras, North Carolina, the coastal morphotype is restricted to waters <25 m deep (Kenney 1990). Similar patterns were observed during summer months in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al.* 2003). However, south of Cape Hatteras during both winter and summer months, there was no clear longitudinal discontinuity in bottlenose dolphin sightings (Garrison and Yeung 2001; Garrison *et al.* 2003).

To address the question of the distribution of coastal and offshore morphotypes in waters south of Cape Hatteras, tissue samples were collected in coastal, shelf and slope waters from New England to Florida between 1997 and 2006. Genetic analyses using mitochondrial DNA sequences of these biopsies identified individual animals to the coastal or offshore morphotype. Using the genetic results from all surveys combined, a logistic regression was used to model the probability that a particular bottlenose dolphin group was of the coastal morphotype as a function of environmental variables including depth, sea surface temperature and distance from shore. These models were used to partition the bottlenose dolphin groups observed during aerial surveys between the two morphotypes (Garrison *et al.* 2003).

The genetic results and spatial patterns observed in aerial surveys indicate both regional and seasonal differences in the longitudinal distribution of the two morphotypes in coastal Atlantic waters. During summer months, all biopsy samples collected from coastal waters north of Cape Lookout, North Carolina (<20 m deep) were of the coastal morphotype, and all samples collected in deeper waters (>40 m deep) were of the offshore morphotype. South of Cape Lookout, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth. In intermediate depth waters, there was spatial overlap between the two morphotypes. Offshore morphotype bottlenose dolphins were observed at depths as shallow as 13 m, and coastal morphotype dolphins were observed at depths of 31 m and 75 km from shore (Garrison *et al*. 2003).

Winter samples were collected primarily from coastal waters in North Carolina and Georgia and the vast majority of them were of the coastal morphotype; however, one offshore morphotype group was sampled during November just south of Cape Lookout only 7.3 km from shore. Coastal morphotype samples were also collected farther away from shore at 33 m depth and 39 km from shore. The logistic regression model for this region indicated a decline in the probability of a coastal morphotype group with increasing distance from shore; however, the model predictions were highly uncertain due to limited sample sizes and spatial overlap between the two morphotypes. Samples collected in Georgia waters also indicated significant overlap between the two morphotypes with a declining probability of the coastal morphotype with increasing depth. A coastal morphotype sample was collected 112 km from shore at a depth of 38 m. An offshore sample was collected in 22 m depth at 40 km from shore. As with the North Carolina model, the Georgia logistic regression predictions are uncertain due to limited sample size and high overlap between the two morphotypes (Garrison *et al.* 2003).

In summary, the primary habitat of the coastal morphotype of bottlenose dolphin in the western North Atlantic extends from Florida to Long Island, New York, during summer months and in waters less than 20 m deep, including estuarine and inshore waters. South of Cape Lookout, the coastal morphotype also occurs in lower densities over the continental shelf and overlaps spatially with the offshore morphotype.

Distinction between Coastal and Estuarine Bottlenose Dolphins

In addition to inhabiting coastal nearshore waters, the coastal morphotype of common bottlenose dolphin also inhabits inshore estuarine waters along the U.S. east coast and Gulf of Mexico (Wells *et al.* 1987; Scott *et al.* 1990; Wells *et al.* 1996; Weller 1998; Zolman 2002; Speakman *et al.* 2006; Stolen *et al.* 2007; Balmer *et al.* 2008; Mazzoil *et al.* 2008). There are multiple lines of evidence supporting demographic separation between bottlenose dolphins residing within different estuaries along the Atlantic coast. For example, long-term photo-identification (photo-ID) studies in waters around Charleston, South Carolina, have identified communities of resident dolphins that are seen within relatively restricted home ranges year-round (Zolman 2002; Speakman *et al.* 2006). In Biscayne Bay, Florida, there is a similar community of bottlenose dolphins with evidence of year-round residents that are genetically distinct from animals residing in a nearby estuary in Florida Bay (Litz *et al.* 2012). A long-term photo-ID study in the Indian River Lagoon system in central Florida has also identified year-round resident dolphins repeatedly observed across multiple years (Stolen *et al.* 2007; Mazzoil *et al.* 2008). A few published studies demonstrate that these resident animals are genetically distinct from animals in nearby coastal waters. A study conducted near Jacksonville, Florida, demonstrated significant genetic differences between animals in coastal and estuarine waters (Caldwell 2001; Rosel *et al.* 2009) and animals resident in the Charleston estuarine system show significant genetic differentiation from animals biopsied in coastal waters of southern Georgia (Rosel *et al*. 2009).

Despite evidence for genetic differentiation between estuarine and coastal populations, the degree of spatial overlap between these populations remains unclear. Photo-ID studies within estuaries demonstrate seasonal immigration and emigration and the presence of transient animals (e.g., Speakman *et al.* 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal or shorter time scales is poorly understood. Bottlenose dolphins inhabiting primarily estuarine habitats are considered distinct stocks from those inhabiting coastal habitats. Bottlenose dolphin stocks inhabiting coastal waters are the focus of this report.

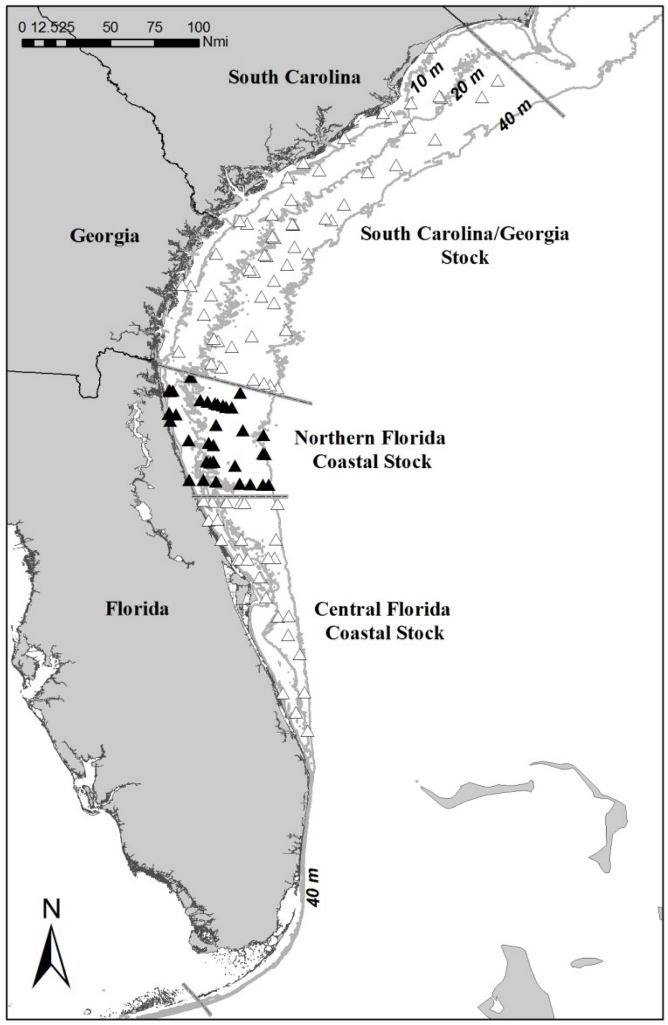

Figure 1. *The Northern Florida Coastal Stock of common bottlenose dolphins (Georgia/Florida border to 29.4°N). Symbols represent all sightings of bottlenose dolphin groups from NMFS 2010 and 2011 aerial surveys; dark symbols- groups within the boundaries of this stock. In waters > 20 m, sightings may include the offshore morphotype of bottlenose dolphins.*

Definition of the Northern Florida Coastal Stock

Initially, a single stock of coastal morphotype common bottlenose dolphins was thought to migrate seasonally between New Jersey (summer months) and central Florida based on seasonal patterns in strandings during a large scale mortality event occurring during 1987-1988 (Scott *et al.* 1988). However, re-analysis of stranding data (McLellan *et al.* 2003) and extensive analysis of genetic (Rosel *et al.* 2009), photo-ID (Zolman 2002) and satellite telemetry (Hansen and Hohn, NMFS unpublished data) data demonstrate a complex mosaic of coastal bottlenose dolphin stocks. Integrated analysis of these multiple lines of evidence suggests that there are five coastal stocks of bottlenose dolphins: the Northern Migratory and Southern Migratory Stocks, a South Carolina/Georgia Coastal Stock, a Northern Florida Coastal Stock and a Central Florida

Coastal Stock.

The spatial extent of these stocks, their potential seasonal movements, and their relationships with estuarine stocks are poorly understood. Migratory movement and spatial distribution of the Northern Migratory Stock is best understood based on tag-telemetry, photo-ID and aerial survey data and migrates seasonally between coastal waters of central North Carolina and New Jersey. It is not thought to overlap with the Northern Florida Coastal Stock in any season. The Southern Migratory Coastal Stock is defined primarily on satellite tag telemetry studies and is thought to migrate south from waters of southern Virginia and north central North Carolina in the summer to waters south of Cape Fear and as far south as coastal Florida during winter months. While it is possible that this stock overlaps during winter with the northern range of the Northern Florida Coastal Stock, more data are needed to confirm this overlap.

During summer months when the Southern Migratory Coastal Stock is found in waters north of Cape Fear, North Carolina, bottlenose dolphins are still seen in coastal waters of South Carolina, Georgia and Florida, indicating the presence of additional stocks of coastal animals. Speakman *et al.* (2006) using photo-ID studies documented dolphins in coastal waters off Charleston, South Carolina, that are not known resident members of the estuarine stock. Genetic analyses of samples from northern Florida, Georgia and central South Carolina (primarily the estuaries around Charleston), using both mitochondrial DNA and nuclear microsatellite markers, indicate significant genetic differences between these areas (NMFS 2001; Rosel *et al.* 2009). This stock assessment report addresses the Northern Florida Coastal Stock, which is present in coastal Atlantic waters from the Georgia/Florida border south to 29.4°N (Figure 1). There is no obvious boundary defining the offshore extent of this stock. The combined genetic and logistic regression analysis (Garrison *et al.* 2003) indicated that in waters less than 10 m depth, 70% of the bottlenose dolphins were of the coastal morphotype. Between 10 and 20 m depth, the percentage of animals of the coastal morphotype dropped precipitously and at depths >40 m nearly all (>90%) animals were of the offshore morphotype. However, in winter months, the Southern Migratory Stock moves into this region in waters 10-30 m depth complicating the ability to define ocean-side boundaries for the Northern Florida Coastal Stock.

POPULATION SIZE

The best available estimate for the Northern Florida Coastal Stock of common bottlenose dolphins in the western North Atlantic is 1,219 (CV=0.67; Table 1). This estimate is from aerial surveys conducted during the summers of 2010 and 2011 covering waters from Florida to New Jersey.

Earlier abundance estimates

Earlier abundance estimates for the Northern Florida Coastal Stock were derived from aerial surveys conducted during the summer of 2002 and 2004. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40 m. These surveys employed two observer teams operating independently on the same aircraft to estimate visibility bias. In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20 m and 20-40 m strata with the majority of effort in the shallow depth stratum. Observed common bottlenose dolphin groups from these were partitioned between the coastal and offshore morphotypes based upon analysis of available biopsy samples (Garrison *et al.* 2003). The previous best abundance estimate was based upon an average of the estimates from the 2002 and 2004 aerial surveys. This estimate was 3,064 (CV=0.24).

Recent surveys and abundance estimates

The Southeast Fisheries Science Center conducted aerial surveys of continental shelf waters along the U.S. East Coast from southeastern Florida to Cape May, New Jersey, during the summers of 2010 and 2011. The surveys were conducted along tracklines oriented perpendicular to the shoreline that were latitudinally spaced 20 km apart and covered waters from the shoreline to the continental shelf break. The summer 2010 survey was conducted during 24 July–14 August 2010, and 7,944 km of on-effort tracklines completed. A total of 127 common bottlenose dolphin groups were observed including 1,541 animals. During the 2011 summer survey, 8,665 km of trackline were completed between Cape May, New Jersey and Ft. Pierce, Florida. The survey was conducted during 6 July - 29 July 2011. The 2011 survey also included more closely spaced “fine-scale” tracklines in waters offshore of New Jersey and Virginia within areas being evaluated for the placement of offshore energy installations. A total of 112 bottlenose dolphin groups were observed including 1,339 animals.

Both the summer 2010 and 2011 surveys were conducted using a two-team approach to develop estimates of visibility bias using the independent observer approach with Distance analysis (Laake and Borchers 2004). However, the detection functions from both surveys indicated a decreased probability of detection near the trackline, which limited the effectiveness of the method for correcting for visibility bias due to a relatively small number of sightings made by both teams near the trackline. Abundance estimates were therefore derived by combining the sightings from both teams during a survey and "left-truncating" the data by analyzing only sightings occurring greater than 100 m from the trackline during the 2010 survey and 50 m during the 2011 survey (Buckland *et al.* 2001). Detection functions were fit to these left-truncated data accounting for the effects of survey conditions (e.g., sea state, glare, water color) on the detection probabilities. A logistic regression model was used to estimate the probability that a given group of dolphins observed during the aerial survey was of the coastal vs. offshore morphotype as a function of water depth (Garrison *et al.* 2003). This probability was incorporated into the abundance estimation to derive an estimate of coastal morphotype dolphins observed during the 2010 and 2011 aerial surveys. A bootstrap resampling approach was used to estimate the variance of the estimates. The resulting abundance estimates assume that detection probability at the truncation distance is equal to 1. While the estimates could not be explicitly corrected for this assumption, analyses of the summer 2010 data suggest that this bias is likely small.

The abundance estimates for the Northern Florida Coastal Stock were based upon tracklines and sightings occurring between the Georgia/Florida border and 29.4°N latitude and in waters from the shoreline to the 40-m isobath. The abundance estimate derived from the summer 2010 survey was 751 (CV=0.83), and the estimate from the summer 2011 survey was 1,730 (CV=0.90). The best estimate is a weighted average of these two with higher weighting given to the more precise estimate from 2010. The resulting best estimate is 1,219 (CV=0.67).

Table 1. Summary of abundance estimates for the western North Atlantic Northern Florida Coastal Stock of common bottlenose dolphins. 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
Summer 2002 and 2004	Georgia/Florida border to 29.4°N latitude	3,064	0.24
Summer 2010 and 2011	Georgia/Florida border to 29.4°N latitude	1,219	0.67

Minimum Population Estimate

The minimum population size (Nmin) for the stock was calculated as the lower bound of the 60% confidence interval for a log-normally distributed mean (Wade and Angliss 1997). The best estimate for the Northern Florida Coastal Stock is 1,219 (CV=0.67). The resulting minimum population estimate is 730.

Current Population Trend

A trend analysis has not been conducted for this stock. There are 2 estimates from the 2002/2004 (3,064; CV=0.24) and 2010/2011 (1,219; CV=0.67) surveys. Methodological differences between the estimates need to be evaluated to quantify trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the western North Atlantic coastal morphotype. 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 Northern Florida Coastal Stock of common bottlenose dolphins is 730. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5 because this stock is depleted. PBR for this stock of common bottlenose dolphins is 7.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the Northern Florida Coastal Stock during 2009–2013 is unknown because this stock is known to interact with unobserved fisheries (see below). The average annual fishery-related mortality and serious injury for strandings identified as fishery-caused was 0.4. No additional mortality or serious injury was documented from other human-caused actions. The minimum total mean annual human-caused mortality and serious injury for this stock during 2009–2013 was 0.4.

Fishery Information

The commercial fisheries that interact, or that potentially could interact, with this stock are the Category II Southeastern U.S. Atlantic shark gillnet; Southeast Atlantic gillnet; and Atlantic blue crab trap/pot fisheries; and the Category III Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fishery. Only limited observer data are available for these and other fisheries that may interact with this stock. Detailed fishery information is presented in Appendix III.

Southeastern U.S. Atlantic Shark Gillnet and Southeast Atlantic Gillnet

Gillnet fisheries targeting finfish and sharks operate in southeast waters between North Carolina and southern Florida. Historically, a drift net fishery targeting coastal sharks operated in waters including within the Northern Florida Coastal Stock boundaries during winter months. Common bottlenose dolphin takes (n=2) in the drift net fisheries were documented in 2002 and 2003 just south of the range of the Northern Florida Coastal Stock (Garrison 2007). Currently, gillnet fisheries include a number of different fishing methods and gear types including drift nets, "strike" fishing, and anchored ("sink") gillnets. The majority of this fishing is reported from waters of North Carolina and central Florida. There have been no observed bottlenose dolphin takes within the stock boundaries.

Atlantic Blue Crab Trap/Pot

During 2009–2013, 1 stranded animal (2009 mortality) assigned to the Northern Florida Coastal Stock was entangled in 2 commercial blue crab traps/pots. The 2 traps were wrapped tightly around the tail stock and fluke juncture. Because there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Hook and Line

During 2009–2013 in the Northern Florida Coastal Stock area, 1 stranded dolphin (2010 mortality) was documented with ingested hook and line gear. It should be noted that, in general, it cannot be determined if hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no systematic observer program.

Other Mortality

During 2009–2013, 138 stranded common bottlenose dolphins were recovered in the waters of the Northern Florida Coastal Stock (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 13 September 2012). It could not be determined if there was evidence of human interaction for 110 of these strandings, and for 20 it was determined there was no evidence of human interaction. The remaining 8 showed evidence of human interactions, including 3 fishery interactions. As mentioned above, 1 of the fishery interactions was an animal entangled in 2 blue crab traps, and another was an animal that had ingested hook and line gear. It is worth noting that during winter months, the Northern Florida Coastal Stock likely overlaps with the Southern Migratory Coastal Stock and it is currently not possible to distinguish between them. Hence during winter months, stranded dolphins could come from either of these 2 stocks. Some (16) of the 138 strandings are also included in the stranding total for the Southern Migratory Coastal Stock. Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al*. 2012; Wells *et al*. 2015). Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al*. 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

An Unusual Mortality Event (UME) was declared in the summer of 2013 for the mid-Atlantic coast from New York to Brevard County, Florida. Beginning in July 2013, bottlenose dolphins have been stranding at elevated rates. The total number of stranded bottlenose dolphins from New York through North Florida (Brevard County) as of mid-October 2014 (1 July 2013 - 19 October 2014) was ~1546. Morbillivirus has been determined to be the cause of the event. Most strandings and morbillivirus positive animals have been recovered from the ocean side beaches rather than from within the estuaries, suggesting that at least so far coastal stocks have been more impacted by this UME than estuarine stocks. However, the UME is still ongoing as of December 2014 when this report was drafted, and work continues to determine the effect of this event on all bottlenose dolphin stocks in the Atlantic.

HABITAT ISSUES

The nearshore and estuarine habitats occupied by the coastal morphotype are adjacent to areas of high human population and some are highly industrialized. The blubber of stranded dolphins examined during the 1987-1988 mortality event contained very high concentrations of organic pollutants (Kuehl *et al*. 1991). More recent studies have examined persistent organic pollutant concentrations in bottlenose dolphin inhabiting estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations, particularly near Charleston, South Carolina, and Beaufort, North Carolina (Hansen *et al.* 2004). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). The exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

STATUS OF STOCK

Common bottlenose dolphins are not listed as threatened or endangered under the Endangered Species Act, but the Northern Florida Coastal Stock is a strategic stock due to the depleted listing under the Marine Mammal Protection Act. 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. This stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units and again in 2008 and 2010 to recognize resident estuarine stocks and migratory and resident coastal stocks. This stock retains the depleted designation as a result of its origins from the originally delineated depleted coastal migratory stock. PBR for the Northern Florida Coastal Stock is 7 and so the zero mortality rate goal, 10% of PBR, is 0.7. The documented mean annual human-caused mortality for this stock for 2009–2013 was 0.4. However, there are several commercial fisheries operating within this stock's boundaries and these fisheries have little to no observer coverage. Therefore, the documented mortalities must be considered minimum estimates of total fishery-related mortality. Insufficient information is available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching a zero mortality and serious injury rate. The status of this stock relative to OSP is unknown. There are insufficient data to determine population trends for this stock.

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