

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Western North Atlantic Southern Migratory 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, coastal animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Rosel *et al.* 2009; Duffield and Wells 2002).

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 (Hoelzel *et al.* 1998; Mead and Potter 1995; 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 warm water months in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al.* 2003). However, south of Cape Hatteras during both cold water and warm water 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 warm water 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).

Cold water month 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 and 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 warm water 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; Wells *et al.* 1996; Scott *et al.* 1990; 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). The Indian River Lagoon system in central Florida also has a long-term photo-ID study, and this study 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.

Definition of the Southern Migratory Coastal Stock

Initially, a single stock of coastal morphotype common bottlenose dolphins was thought to migrate seasonally between New Jersey (warm water 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 (Hohn and Hansen, 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 5 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.

Among the coastal stocks, the migratory movements and spatial distribution of the Southern Migratory Stock are the most poorly understood. Stable isotope analysis conducted using biopsy samples from free-ranging animals sampled in estuarine, nearshore coastal and offshore habitats suggested migratory movement of animals in coastal waters between Georgia in the cold water months and southern North Carolina during warm water months. In that study, $^{15}\text{N}/^{14}\text{N}$, and $^{34}\text{S}/^{32}\text{S}$ ratios of animals sampled off of Georgia during cold water months were similar to those of animals sampled in waters off of southern North Carolina, near Cape Fear, during cold water months (Knoff 2004). Satellite tag telemetry studies also provide evidence for a stock of dolphins migrating seasonally along the coast between North Carolina and northern Florida. Four dolphins were tagged during November 2004 just south of Cape Fear, North Carolina. One of these animals remained along the South Carolina and southern North Carolina coasts throughout January-February while another migrated south to Northern Florida through February. During March-June, these animals moved further north of the tagging site to Cape Hatteras, North Carolina. The tags did not last beyond June, and therefore, the movements of these animals after that time is unknown (Hohn and Hansen, NMFS unpublished data).

Genetic analyses indicate significant differentiation between bottlenose dolphins occupying coastal waters from the North Carolina/Virginia border to New Jersey during warm water months and those in southern North Carolina and further south (Rosel *et al.* 2009). In addition, tagging studies of animals occupying New Jersey waters during the warm water months indicate that animals from the Northern Migratory Coastal Stock do not move south of Cape Lookout, North Carolina during cold water months. These data support the hypothesis that the Northern Migratory Coastal Stock is distinct from the Southern Migratory Coastal Stock.

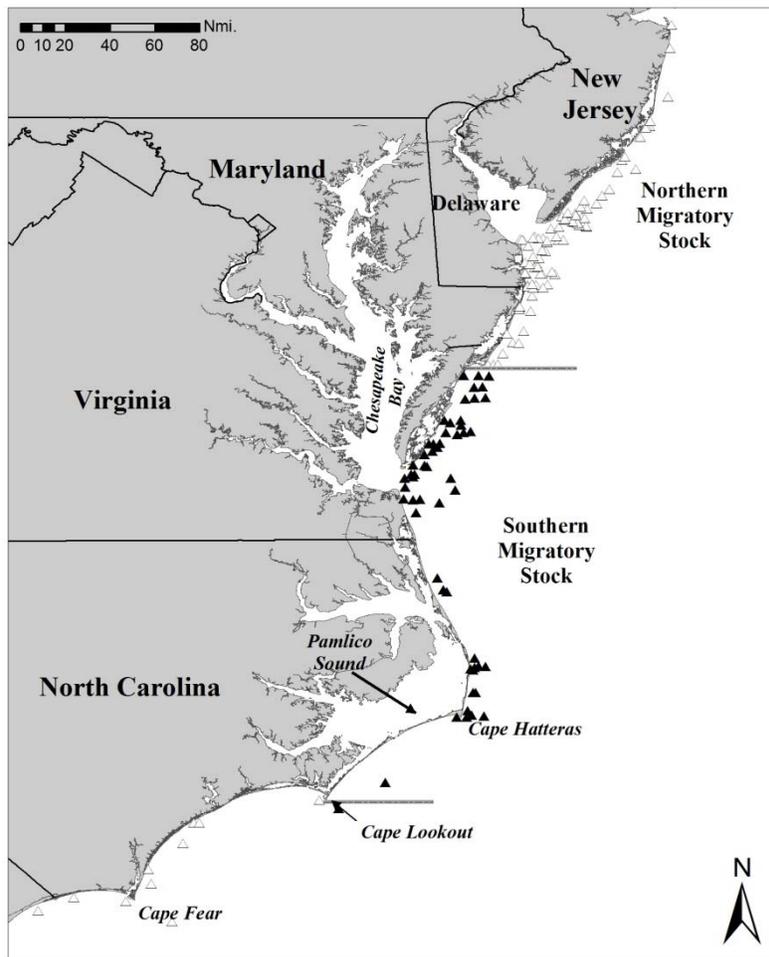


Figure 1. The distribution of common bottlenose dolphin stocks occupying coastal waters from North Carolina to New Jersey during July-August 2002, 2004, 2010 and 2011. Sighting locations from aerial surveys are plotted as triangle symbols. Sightings assigned to the Southern Migratory Coastal Stock are shown as filled symbols. Horizontal lines intersecting the coast denote the northern and southern boundaries for the Southern Migratory Coastal Stock in warm water months.

In summary, the limited data available support the definition of a Southern Migratory Stock of coastal morphotype bottlenose dolphins; however, there is a large amount of uncertainty in its spatial movements. The seasonal movements are best described by tag telemetry data. During October-December, telemetry data suggest this stock occupies waters of southern North Carolina (south of Cape Lookout) where it may overlap spatially with the Southern North Carolina Estuarine System Stock in coastal waters. During January-March, the Southern Migratory Stock appears to move as far south as northern Florida where it overlaps spatially with the South Carolina/Georgia and Northern Florida Coastal Stocks. During April-June, the stock moves north to North Carolina where it overlaps with the Southern North Carolina Estuarine System Stock and the Northern North Carolina Estuarine System Stock. During July-August, the stock is presumed to occupy coastal waters north of Cape Lookout, North Carolina, to the eastern shore of Virginia (Figure 1). It is possible that these animals also occur inside the Chesapeake Bay and in nearshore coastal waters where there is evidence that Northern North Carolina Estuarine System Stock animals also occur.

POPULATION SIZE

The best available estimate for the Southern Migratory Coastal Stock of common bottlenose dolphins in the western North Atlantic is 9,173 (CV=0.46; 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 Southern Migratory Coastal Stock were derived from aerial surveys conducted during the summer of 2002. 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). For the region north of Cape Hatteras, North Carolina, there was complete separation between the coastal and offshore morphotypes, with only coastal animals occupying waters < 20 m deep. Therefore, all animals observed in the 0-20 m depth stratum during surveys of this region were assigned to the coastal morphotype (Garrison *et al.* 2003).

Summer surveys are best for estimating the abundance for both the Northern and Southern Migratory Coastal Stocks because they overlap least with other stocks during summer months. An analysis of summer survey data from 1995, 2002 and 2004 demonstrated strong inter-annual variation in the spatial distribution of presumed Northern and Southern Migratory Coastal Stock animals. Two groups of dolphins in each survey year were identified using a multivariate cluster analysis of sightings based on water temperature, depth and latitude. One group ranged from Cape Lookout, North Carolina, to just north of the Chesapeake Bay mouth, and one ranged farther north along the eastern shore of Virginia to New Jersey. The southern group (i.e., the Southern Migratory Coastal Stock) was found in water temperatures between 26.5 and 28.0°C, and the northern group (i.e., the Northern Migratory Coastal Stock) occurred in cooler waters between 24.5 and 26.0°C. The spatial distribution of these groups was strongly correlated with water temperatures and varied between years. During the summer of 2004, water temperatures were significantly cooler than those during 2002, and animals from both groups were distributed farther south and overlapped spatially. Very few bottlenose dolphins were observed in waters north of Virginia during the summer 2004 survey. Therefore, it was not possible to develop an estimate of abundance for the Southern Migratory Coastal Stock from the summer 2004 survey, and so the best abundance estimate for the Southern Migratory Stock came from the summer 2002 survey when there was little overlap and an apparent separation from the Northern Migratory Coastal Stock at approximately 37.5°N latitude. The resulting abundance estimate for the Southern Migratory Coastal Stock was 12,482 (CV=0.32).

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 were 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 (see Buckland *et al.* 2001 for left-truncation methodology). 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 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 Southern Migratory Coastal stock were based upon tracklines and sightings occurring between Cape Lookout, North Carolina, and Assateague, Virginia (37.5°N latitude) and in waters from the shoreline to the 20-m isobath. Prior analyses suggested that this latitudinal boundary separates the Northern and Southern Migratory Coastal Stocks. The abundance estimate derived from the summer 2010 survey was 10,093 (CV=0.52), and the estimate from the summer 2011 survey was 7,472 (CV=0.96). 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 9,173 (CV=0.46).

Table 1. Summary of abundance estimates for the western North Atlantic Southern Migratory 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
July-August 2002	North Carolina to Virginia	12,482	0.32
July-August 2010 and 2011	North Carolina to Virginia	9,173	0.46

Minimum Population Estimate

The minimum population size (N_{min}) was calculated as the lower bound of the 60% confidence interval for a lognormally distributed mean (Wade and Angliss 1997). The best estimate for the Southern Migratory Coastal Stock of common bottlenose dolphins is 9,173 (CV=0.46). The resulting minimum population estimate is 6,326.

Current Population Trend

A trend analysis has not been conducted for this stock. There are 2 estimates from the 2002 (12,482; CV=0.32) and 2010/2011 (9,173; CV=0.46) surveys. Methodological differences among 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 Southern Migratory Coastal 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 Southern Migratory Coastal Stock of common bottlenose dolphins is 6,326. 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 bottlenose dolphins is 63.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the Southern Migratory Coastal Stock during 2009–2013 is unknown because this stock is known to interact with unobserved fisheries (see below). The mean annual fishery-related mortality and serious injury for observed fisheries and strandings identified as fishery-caused ranged between 0 and 11.6. Additional mean annual mortality and serious injury due to other human-caused actions (fishery research) ranged from 0 to 0.4. The minimum total mean annual human-caused mortality and serious injury for this stock during 2009–2013 ranged between 0 and 12.0. This range reflects the uncertainty in assigning observed or reported mortalities to a particular stock.

Fishery Information

The commercial fisheries that interact, or that potentially could interact, with this stock are the Category I mid-Atlantic gillnet fishery; the Category II Chesapeake Bay inshore gillnet; Virginia pound net; Atlantic blue crab trap/pot; North Carolina roe mullet stop net; mid-Atlantic menhaden purse seine; mid-Atlantic haul/beach seine; Southeastern U.S. Atlantic shark gillnet; and Southeast Atlantic gillnet fisheries; and the Category III Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fishery. Detailed fishery information is presented in Appendix III.

With the exception of the mid-Atlantic gillnet fishery and U.S. Atlantic shark gillnet fishery, the above fisheries have limited or no systematic federal observer coverage, which prevents the estimation of total takes. The primary known source of estimated fishery mortality is the mid-Atlantic gillnet fishery, which affects the Northern Migratory, Southern Migratory, Northern North Carolina Estuarine System (NNCES) and Southern North Carolina Estuarine System (SNCES) Stocks of common bottlenose dolphins. Additional commercial trap/pot fisheries may impact the Southern Migratory Coastal Stock. At certain times of year, it is not possible to definitively assign

mortalities to a specific stock because of the overlap amongst the 4 stocks around North Carolina.

Mid-Atlantic Gillnet

Background

This fishery has the highest documented level of mortality of coastal morphotype common bottlenose dolphins, and sink gillnet gear in North Carolina is its largest component in terms of fishing effort and observed takes. Because the Northern Migratory Coastal, Southern Migratory Coastal, NNCS and SNCS bottlenose dolphin stocks all occur in waters off of North Carolina, it is not possible to definitively assign every observed mortality, or extrapolated bycatch estimate, to a specific stock. Between 1995 and 2000 a total of 14 takes occurred, 13 mortalities and 1 live release: 1 in 1995 (mixed finfish), 1 in 1996 (spanish mackerel), 3 in 1998 (1 smooth dogfish, 1 spiny dogfish and 1 in beach-anchored gillnet targeting weakfish), 5 in 1999 (2 spiny dogfish, 1 striped bass, 1 shark, and 1 live release from gear targeting spanish mackerel), 4 in 2000 (1 kingfish, 1 spiny dogfish, 1 bluefish/smooth dogfish, and 1 in beach-anchored gillnet targeting striped bass). The observed takes occurred in gear off North Carolina (n=10), Virginia (n=2) and New Jersey (n=2).

The Bottlenose Dolphin Take Reduction Team was convened in October 2001, in part, to reduce bycatch in gillnet gear. While the Bottlenose Dolphin Take Reduction Plan (BDTRP) was being developed and implemented, there were 7 additional bottlenose dolphin mortalities observed in the mid-Atlantic gillnet fishery from 2001-2006. Three mortalities were observed in 2001 with 1 occurring off of northern North Carolina during April (monkfish fishery) and 2 occurring off of Virginia during November (striped bass fishery). Four additional mortalities were observed along the North Carolina coast near Cape Hatteras: 1 in May 2003 (Spanish mackerel), 1 in September 2005 (Spanish mackerel), 1 in September 2006 (Spanish mackerel), and 1 in October 2006 (king mackerel). The BDTRP was implemented in May 2006 and resulted in changes to gillnet gear configurations and fishing practices.

During 2007-2011 only 1 take was observed by the Southeast Fisheries Observer Program off the coast of northern North Carolina during the month of October. There were no observed takes by the Northeast Fisheries Observer Program (NEFOP) during 2007-2011.

Pre-Take Reduction Plan Mortality Estimation (2002-2006)

All available data from 1995 to 2006 were used to estimate total mortality of common bottlenose dolphins in the mid-Atlantic gillnet fishery. Three alternative approaches were used to estimate a pre-BDTRP bycatch rate for the period 2002-April 2006. First, a generalized linear model (GLM) approach was used similar to that described in Palka and Rossman (2001). The dataset used in the GLM approach included all observed trips and mortalities from 1995 to April 2006 filtered to include only trips that reflected fishing practices in effect during the period from 2002 to April 2006. Second, a simple ratio estimator of catch per unit effort (CPUE = observed catch / observed effort) was used based directly upon the observed data collected from 2002 to April 2006. Finally, a ratio estimator pooled across years 2002-April 2006 was used to estimate different CPUE values for the pre-BDTRP period. In each case, the annual reported fishery effort (represented as reported landings) was multiplied by the estimated bycatch rate to develop annual estimates of fishery-related mortality, again similar to the approach in Palka and Rossman (2001). To account for the uncertainty among the 3 alternative approaches, the average of the 3 model estimates (and the associated uncertainty) was used to estimate the mortality of bottlenose dolphins for this fishery (Table 2). The live release from 1999 and 2 takes from beach anchored gillnets reported in the background text were not included in this analysis. Only years 2002-Apr 2006 are reported here as a new analytical approach is described below for the most recent 5-year mortality analysis covering calendar years 2007-2011.

Table 2. Summary of the 2002-2006 incidental mortality of common bottlenose dolphins in the Southern Migratory Coastal Stock in commercial mid-Atlantic gillnet fisheries. The estimated annual and average mortality estimates are shown for the period prior to the implementation of the Bottlenose Dolphin Take Reduction Plan (pre-BDTRP) and after the implementation of the plan (post-BDTRP). Three alternative modeling approaches were used, and the average of the 3 was used to represent mortality estimates. The minimum and maximum estimates indicate the range of uncertainty in assigning observed bycatch to stock. Observer coverage is measured as a proportion of reported landings (tons of fish landed). Data are derived from the Northeast Observer program, NER dealer data, VMRC landings and NCDMF dealer data. Values in parentheses indicate the CV of the estimate. GLM = generalized linear model.

Period	Year	Observer Coverage	Min Annual Ratio	Min Pooled Ratio	Min GLM	Max Annual Ratio	Max Pooled Ratio	Max GLM
pre-BDTRP	2002	0.01	0	29.17 (0.97)	6.71 (0.40)	0	67.83 (0.68)	24.22 (0.45)
	2003	0.01	0	34.77 (0.68)	12.35 (0.36)	63.56 (0.99)	47.08 (0.97)	14.00 (0.40)
	2004	0.02	0	81.52 (0.97)	18.93 (0.39)	0	88.56 (0.68)	31.71 (0.45)
	2005	0.03	114.84 (1)	74.05 (0.68)	19.41 (0.42)	123.18 (1.02)	91.01 (0.97)	26.61 (0.45)
	Jan-Apr 2006	0.03	0	0	0.00	0	0	0.32 (0.42)
Annual Avg. pre-BDTRP			Minimum: 21.81 (CV=0.13)			Maximum: 34.03 (CV=0.12)		

During 2002-2006, there were 4 observed takes in the mid-Atlantic gillnet fishery that could potentially be assigned to the Southern Migratory Coastal Stock. Three of these occurred relatively close to shore and in areas of potential overlap with the NNCES Stock. A fourth occurred several kilometers from shore in northern North Carolina during summer months and, therefore, is most likely to be from the Southern Migratory Coastal Stock. As stated previously, observed mortalities (and effort) cannot be definitively assigned to a particular stock within certain regions and times of year; therefore, the minimum and maximum possible mortality of the Southern Migratory Coastal Stock are presented for comparison to PBR (Table 2).

Based upon these analyses, the minimum and maximum mean mortality estimates for the Southern Migratory Coastal Stock for the pre-BDTRP period (2002-Apr 2006) were 21.81 (CV=0.13) and 34.03 (CV=0.12) animals per year, respectively (Table 2).

Post-Take Reduction Plan Mortality Estimation (2007-2011)

Different from the pre-BDTRP analytical approach, only 2 alternative approaches were used to estimate common bottlenose dolphin bycatch rates during the post-BDTRP period: 1) a simple annual ratio estimator of CPUE per year based directly upon the observed data from 2007-2011 and 2) a pooled CPUE (where all observer data from 2007-2011 were combined into one sample to estimate CPUE). In each case, the annual reported fishery effort (defined as a fishing trip) was multiplied by the estimated bycatch rate to develop annual estimates of fishery-related mortality. There were not enough observed take events in the post-BDTRP data set to run a GLM. Similar to the pre-BDTRP analytical approach, to account for the uncertainty in these 2 alternative approaches, the average of the 2 model estimates (and the associated uncertainty) were used to estimate the mean mortality of common bottlenose dolphins for this fishery (Table 3). It should be noted that internal waters of Virginia and Maryland (*i.e.*, Chesapeake Bay) may be important habitat to the Southern Migratory Coastal Stock and were included in the estimation of bycatch mortality during 2007-2011.

During 2007-2011, 1 bottlenose dolphin take was observed (2009) by the Southeast Fishery Observer Program (SEFOP) off northern North Carolina that could potentially be assigned to the NNCES or the Northern or Southern Migratory Coastal Stocks. The animal was observed within 1.1 km of shore in a region where it is possible the estuarine animals can overlap in time and space with coastal migratory bottlenose dolphins. There were no takes

observed by the Northeast Fisheries Observer Program (NEFOP) during 2007-2011. The combined NEFOP and SEFOP average observer coverage (measured in trips) for this fishery from 2007-2011 was 2.95% in state waters (0-3 miles) and 8.59% in federal waters (3-200 miles). The low level of coverage in state waters is likely insufficient to consistently detect rare bycatch events of common bottlenose dolphins in the mid-Atlantic commercial gillnet fishery.

Based upon these analyses, the minimum and maximum mean mortality estimates for the Southern Migratory Coastal Stock for the post-BDTRP period (2007-2011) were 0 and 10.94 (CV=0.30) animals per year, respectively (Table 3). However, based on documented serious injury and mortality in this fishery from both federal observer coverage and other data sources (see Table 4), mean annual mortality estimates are likely not zero. Specifically, in 2011 the stranding network recovered a dead dolphin from a fisherman who had incidentally caught it in a small-mesh gillnet targeting spot in southern North Carolina. This animal could have belonged to the Southern Migratory Coastal or SNCES Stock, and was included in the stranding database and the stranding totals in Table 5. Incidental takes have also been documented in research gillnet gear fished similarly to commercial gear (see Other Mortality section).

Table 3. Summary of 2007-2011 incidental mortality of common bottlenose dolphins in the Southern Migratory Coastal Stock in the commercial mid-Atlantic coastal gillnet fisheries. An average from two alternative analytical approaches was used to estimate total bycatch mortality. The minimum and maximum estimates indicate the range of uncertainty in assigning observed bycatch to a stock. Observer coverage is reported on an annual basis for the entire mid-Atlantic coastal gillnet fishery (excluding internal waters) as a proportion of total trips sampled. Data sources include the Northeast and Southeast Fisheries Observer Programs, Greater Atlantic Regional Fisheries Office Vessel Trip Reports, Virginia Marine Resources Commission Fisheries Landings, and North Carolina Division of Marine Fisheries Trip Ticket Program. Values in parentheses indicate the CV of the estimate.

Year	Observer Coverage	Min Annual Ratio	Min Pooled Ratio	Max Annual Ratio	Max Pooled Ratio
2007	0.05	0.00	0.00	0.00	12.01 (0.97)
2008	0.04	0.00	0.00	0.00	10.54 (0.97)
2009	0.04	0.00	0.00	64.18 (0.99)	11.04 (0.97)
2010	0.04	0.00	0.00	0.00	8.23 (0.97)
2011	0.02	0.00	0.00	0.00	8.67 (0.97)
Mean	0.04	0.00	0.00	12.84 (0.99)	10.10 (0.44)
		Mean Minimum: 0.00		Mean Maximum ¹ : 10.94 (0.30)	

¹Mean weighted by inverse of CVs and CV equals inverse of sum of weights

Chesapeake Bay Inshore Gillnet

During 2009–2013, there was 1 documented interaction between common bottlenose dolphins and inshore gillnet gear in Chesapeake Bay. In 2013 in Maryland, a dead dolphin was recovered entangled in 9-inch stretched mesh gillnet gear. This animal likely belonged to either the Northern or Southern Migratory Coastal Stock, and was included in the stranding database and the stranding totals presented in Table 5 (Northeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 17 June 2014). There is no observer coverage of this fishery within Maryland waters of Chesapeake Bay; within Virginia waters of Chesapeake Bay, there is a low level of observer coverage (<1%).

Virginia Pound Net

Historical and recent stranding network data report interactions between common bottlenose dolphins and pound nets in Virginia. During 2009–2013, 5 bottlenose dolphin strandings which could have belonged to the

Southern Migratory Coastal Stock were entangled in pound net gear in Virginia (4 in 2009, 1 in 2011; Northeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 17 June 2014). An additional 15 dolphins that could have belonged to the Southern Migratory Coastal Stock stranded with twisted twine markings indicative of interactions with pound net gear. These interactions occurred primarily inside estuarine waters near the mouth of the Chesapeake Bay and in summer months. The overall impact of the Virginia pound net fishery on the Southern Migratory Coastal Stock is unknown due to the limited information on the stock's movements, particularly whether or not it occurs within waters inside the mouth of the Chesapeake Bay.

Atlantic Blue Crab Trap/Pot

During 2009–2013, there was 1 reported mortality in 2009 of a common bottlenose dolphin entangled in blue crab trap/pot gear that could have belonged to either the Southern Migratory Coastal or SMCES Stock. Because there is no observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots. However, stranding data indicate that interactions with trap/pot gear occur at some unknown level in North Carolina (Byrd *et al.* 2014) and other regions of the southeast U.S. (Noke and Odell 2002; Burdett and McFee 2004).

North Carolina Roe Mullet Stop Net

During 2009–2013, there was 1 reported mortality for which an animal was entangled in a stop net. This mortality occurred during November 2013 and the animal likely belonged to the SMCES or Southern Migratory Coastal Stock. This mortality was included in the stranding database and in the stranding totals presented in Table 5. This fishery has not had regular, ongoing federal or state observer coverage. However, the NMFS Beaufort laboratory observed this fishery in 2001-2002 (Byrd and Hohn 2010), and Duke University observed the fishery in 2005-2006 (Thayer *et al.* 2007). Entangled dolphins were not documented during these formal observations, but opportunistically observed historical takes of dolphins entangled in stop nets occurred in 1993 and 1999.

Mid-Atlantic Menhaden Purse Seine

The mid-Atlantic menhaden purse seine fishery historically reported an annual incidental take of 1 to 5 common bottlenose dolphins (NMFS 1991, pp. 5-73). This information has not been updated for some time. There has been very limited observer coverage since 2008, but no takes have been observed (see Appendix III).

Mid-Atlantic Haul/Beach Seine

There were no reports of mortality or serious injury during 2009–2013 in the mid-Atlantic haul/beach seine fishery, and no estimate of bycatch mortality is available. The mid-Atlantic haul/beach seine fishery had limited observer coverage by the NEFOP in 2009-2011. No observer coverage was allocated to this fishery in 2012 or 2013. Recent evidence for bycatch risk in this gear is limited. The most recent documented interaction is from 2007 when 1 dolphin was killed in a multifilament beach seine during a research project performed by the North Carolina Division of Marine Fisheries. This animal likely belonged to either the Northern Migratory or Southern Migratory Coastal Stock based on its location north of Oregon Inlet during June.

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 in northern Florida during winter months that could have interacted with the Southern Migratory Stock. Bottlenose dolphin takes (n=2) in the drift net fisheries in this area were documented in 2002 and 2003 (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, and very little effort is reported during winter months (January-March) within the range of the Southern Migratory Stock.

Hook and Line

During 2009–2013, 5 common bottlenose dolphin strandings (mortalities) that could have belonged to the Southern Migratory Coastal Stock were documented with evidence of hook and line gear ingestion or entanglement. During 2010 in South Carolina an animal that may have belonged to this stock or to the South Carolina/Georgia Coastal Stock was documented with ingested hook and line gear (wrapped around its goosbeak). In 2011 an additional animal stranded in South Carolina that may have belonged to this stock or to the South Carolina/Georgia Coastal Stock, and it had also ingested hook and line gear. In 2011 in Virginia, a dolphin that could have belonged

to this stock or the NNCES Stock was documented entangled in hook and line gear. In 2012 in North Carolina, a dolphin that could have belonged to this stock or the NNCES Stock was documented with ingested hook and line gear. Finally, in 2012 in Virginia, a dolphin that could have belonged to this stock or the Northern Migratory Coastal Stock was documented entangled in hook and line gear. These mortalities were included in the stranding database and are included in the stranding totals presented in Table 5. 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

Historically and in recent years there have been occasional mortalities of bottlenose dolphins during research activities. One mortality was observed in research gear during 2009 in a small-mesh gillnet targeting Spanish mackerel, and a second mortality was observed in research gear during 2010 in a medium-mesh gillnet targeting sharks. These mortalities could have belonged to the NNCES or Southern Migratory Coastal Stock. The mortalities were included in the stranding database and are included in Table 5. All mortalities from known sources including commercial fisheries and research-related mortalities for the Southern Migratory Coastal Stock are summarized in Table 4.

Table 4. Summary of annual reported and estimated human-caused mortality of common bottlenose dolphins from the Southern Migratory Coastal Stock during 2009–2013 from observer data, stranding data and research takes. Where minimum and maximum values are reported in individual cells, there is uncertainty in the assignment of mortalities to this particular stock due to spatial overlap with other bottlenose dolphin stocks in certain areas and seasons. This is especially the case for strandings where the maximum number reported may truly be a minimum because not all strandings are detected. Therefore, to account for both scenarios, the maximum numbers under the total column are reported as the maximum greater than or equal to what was recovered.

Year	Mid-Atlantic Gillnet		Chesapeake Bay Inshore Gillnet (strandings)	Virginia Pound Net (strandings and observed)	Blue Crab Pot (strandings)	Hook and Line (strandings)	Research (incidental takes)	Total ^b
	Min/Max estimate extrapolated from observer data (only through 2011) ^a	Interactions known from stranding data or observer data						
2009	Min = 0 Max = 37.61	Min = 0 Max = 1	0	Min = 0 Max = 4	Min = 0 Max = 1	0	Min = 0 Max = 1	Min = 0 Max ≥ 43.61
2010	Min = 0 Max = 4.11	0	0	0	0	Min = 0 Max = 1	Min = 0 Max = 1	Min = 0 Max ≥ 6.11
2011	Min = 0 Max = 4.33	Min = 0 Max = 1	0	Min = 0 Max = 1	0	Min = 0 Max = 2	0	Min = 0 Max ≥ 7.33
2012	No estimate ^c	0	0	0	0	Min = 0 Max = 2	0	Min = 0 Max ≥ 2
2013	No estimate ^c	0	Min = 0 Max = 1	0	0	0	0	Min = 0 Max ≥ 1
Annual Average Mortality (2009–2013)				Minimum Estimated = 0 Maximum Estimated ≥ 12.0				

^a Where given, these numbers are the average of the 2 minimum and 2 maximum mortality estimates for that year from Table 3.

^b In years with bycatch estimates for the mid-Atlantic gillnet fishery, stranded animals recovered with gillnet gear attached would be accounted for in the estimate for that year. Therefore, stranded animals with attached gear are only included in the Total column when no bycatch estimate has been calculated for that year.

^c Mortality analyses that use observer data are updated every 3 years. The next update is scheduled for 2015 and will include mortality estimates for years 2012-2014.

Strandings

During 2009–2013, 895 common bottlenose dolphins stranded along the Atlantic coast between Florida and Virginia that could potentially be assigned to the Southern Migratory Stock (Table 5; Northeast Regional Marine Mammal Stranding Network; Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11 June 2014 (SER) and 17 June 2014 (NER)). It could not be determined if there was evidence of human interaction for 620 of these strandings, and for 175 it was determined there was no evidence of human interaction. The remaining 100 showed evidence of human interactions, of which 73 were fisheries interactions (Table 5). It should be recognized that evidence of human interaction does not indicate cause of death, but rather only that there was evidence of interaction with a fishery (e.g., line marks, net marks) or evidence of a boat strike, gunshot wound, mutilation, etc., at some point. Also, 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.

The assignment of animals to a particular stock is impossible in some seasons and regions. During warm water months in North Carolina, Virginia and Maryland, the stock overlaps with the Northern Migratory Coastal, Northern North Carolina Estuarine System and the Southern North Carolina Estuarine System Stocks. During cold water months, the stock overlaps with the Southern North Carolina Estuarine System Stock, the South Carolina/Georgia Coastal Stock, and the Northern Florida Coastal Stock. Therefore, the counts in Table 5 likely include some animals from these other stocks and therefore overestimate the number of strandings for the Southern Migratory Coastal Stock; those strandings that could not be definitively assigned to the Southern Migratory Coastal Stock were also included in the counts for these other stocks as appropriate. In addition, stranded carcasses are not routinely identified to either the offshore or coastal morphotype of bottlenose dolphin, therefore it is possible that some of the reported strandings were of the offshore form though that number is likely to be low (Byrd *et al.* 2014).

An Unusual Mortality Event (UME) was declared in South Carolina during February-May 2011. Six strandings assigned to the Southern Migratory Coastal Stock were considered to be part of the UME. The cause of this UME is still under investigation. A 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.

Table 5. Strandings of common bottlenose dolphins from Virginia to Florida during 2009–2013 that could have belonged to the Southern Migratory Coastal Stock. Assignments to stock were based upon the understanding of the seasonal movements of this stock. However, in waters of North Carolina and Virginia there is likely overlap with other stocks during particular times of year. HI = Evidence of Human Interaction, CBD = Cannot Be Determined whether an HI occurred or not. NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11 June 2014 (SER) and 17 June 2014 (NER).

State	2009			2010			2011			2012			2013		
	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
Maryland ^a	0	0	0	0	0	0	0	0	1	0	0	0	1 ^b	0	8
Virginia ^a	14 ^c	6	54	7 ^d	6	38	7 ^e	5	31	6 ^f	5	32	14 ^g	31	280
North Carolina ^h	9 ⁱ	5	19	6 ^j	17	18	10 ^k	13	20	11 ^l	10	12	10 ^m	54	63
South Carolina ⁿ (Dec-Mar)	0	4	2	1 ^o	3	1	1 ^p	2	5	0	5	2	0	5	12
Georgia ^q (Jan-Feb)	0	0	0	0	0	2	2	0	2	0	1	0	0	1	5
Florida ^q (Jan-Feb)	0	1	1	0	0	3	0	1	4	0	0	2	1	0	3
Annual Total	115			102			104			86			488		

^a Strandings from Virginia and Maryland were assigned to stock based upon location and time of year with most occurring between May and September that could be assigned to the Southern Migratory Coastal Stock. Some of these strandings could also be assigned to the Northern Migratory Coastal Stock or Northern North Carolina Estuarine System Stock.

^b Includes 1 fisheries interaction (FI) that was an entanglement interaction with gillnet gear (mortality, Chesapeake Bay inshore gillnet fishery).

^c Includes 14 FIs, 4 of which were entanglement interactions with Virginia pound nets (mortalities) and 8 FIs that were mortalities with twisted twine markings indicative of interactions with Virginia pound net gear.

^d Includes 5 FIs, 4 of which were mortalities with twisted twine markings indicative of interactions with Virginia pound net gear.

^e Includes 6 FIs. One FI was an entanglement interaction with hook and line gear (mortality), 1 was an entanglement interaction in a Virginia pound net (mortality), and 2 were mortalities with twisted twine markings indicative of interactions with Virginia pound net gear.

^f Includes 3 FIs, 1 of which was an entanglement interaction with hook and line gear (mortality).

^g Includes 9 FIs, 1 of which was a mortality with twisted twine markings indicative of an interaction with Virginia pound net gear.

^h Strandings from North Carolina were assigned based on location and time of year. During summer and fall, some of these strandings could also be assigned to the Northern North Carolina Estuarine System or Southern North

Carolina Estuarine System Stocks.

ⁱ Includes 8 FIs, 1 of which was an entanglement interaction with commercial blue crab trap/pot gear (mortality). Also includes 1 incidental take in research gillnet gear (mortality).

^j Includes 3 FIs, 1 of which was an and 1 incidental take in research experimental gillnet gear targeting shark (mortality).

^k Includes 7 FIs, 1 of which was an entanglement interaction with gillnet gear (mortality, mid-Atlantic gillnet fishery).

^l Includes 8 FIs, 3 of which had markings indicative of interactions with gillnet gear (mortalities), and 1 in which an animal ingested hook and line gear (mortality).

^m Includes 7 FIs, 1 of which was an entanglement in a stop net (mortality, North Carolina roe mullet stop net fishery).

ⁿ Strandings in coastal waters from South Carolina during December-March are potentially from the Southern Migratory Coastal Stock or the South Carolina/Georgia Coastal Stock.

^o Includes 1 FI in which an animal ingested hook and line gear (mortality).

^p Includes 1 FI in which an animal ingested hook and line gear (mortality).

^q Strandings in Georgia and northern Florida during January and February could also be assigned to the South Carolina/Georgia or the Northern Florida Coastal Stocks, respectively.

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 common bottlenose dolphin tissues from several estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly in estuaries near Charleston, South Carolina, and Beaufort, North Carolina (Hansen *et al.* 2004), and in portions of Biscayne Bay, Florida (Litz *et al.* 2007). 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 Southern Migratory Coastal Stock is a strategic stock due to the depleted listing under the MMPA. From 1995 to 2001, NMFS recognized only a single migratory stock of coastal morphotype 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 2009 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 original western North Atlantic Coastal Stock. PBR for the Southern Migratory Coastal Stock is 63 and so the zero mortality rate goal, 10% of PBR, is 6.3. The documented mean annual human-caused mortality for this stock for 2009 – 2013 ranged between a minimum of 0 and a maximum of 12.0. However, these estimates are biased low for the following reasons: 1) the total U.S. human-caused mortality and serious injury for the Southern Migratory Coastal Stock cannot be directly estimated because of the spatial overlap among the stocks of bottlenose dolphins that occupy waters of North Carolina; 2) the mean annual fishery-related mortality from the mid-Atlantic gillnet fishery does not include estimates from the observer component for years 2012-2013; and 3) there are several commercial fisheries operating within this stock's boundaries that have little to no observer coverage. Therefore, the documented mortalities must be considered minimum estimates of total fishery-related mortality. There is insufficient information available to determine whether the total fishery-related mortality and serious injury is 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.

REFERENCES CITED

Balmer, B.C., R.S. Wells, S.M. Nowacek, D.P. Nowacek, L.H. Schwacke, W.A. McLellan, F.S. Scharf, T.K. Rowles, L.J. Hansen, T.R. Spradlin and D.A. Pabst. 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. *J. Cetacean Res.*

- Manage. 10: 157-167.
- Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background and a Summary of the 1995 Assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.
- Buckland, S. T., D. R. Andersen, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York. 432 pp.
- Burdett, L.G. and W.E. McFee. 2004. Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the Atlantic blue crab fishery categorization. J. Cetacean Res. Manage. 6(3): 231-240.
- Byrd, B.L. and A.A. Hohn. 2010. Challenges of documenting *Tursiops truncatus* Montagu (bottlenose dolphin) bycatch in the stop net fishery along Bogue Banks, North Carolina. Southeast. Nat. 9(1): 47-62.
- Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112: 1-23.
- Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. dissertation from University of Miami. 143 pp.
- Duffield, D.A. and R.S. Wells 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. pp. 3-11. In: C. J. Pfeiffer, (ed.) Cell and Molecular Biology of Marine Mammals. Krieger Publishing, Melbourne, FL. 464 pp.
- Garrison, L.P. 2007. Estimated marine mammal and turtle bycatch in shark gillnet fisheries along the Southeast US Atlantic coast: 2000-2006. NMFS Southeast Fisheries Science Center. PRD Contribution #PRBD-07/08-02. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
- Garrison, L.P., P.E. Rosel, A.A. Hohn, R. Baird and W. Hoggard. 2003. Abundance of the coastal morphotype of bottlenose dolphin *Tursiops truncatus*, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
- Garrison, L.P. and C. Yeung. 2001. Abundance estimates for Atlantic bottlenose dolphin stocks during summer and winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
- Hansen, L.J., L.H. Schwacke, G.B. Mitchum, A.A. Hohn, R.S. Wells, E.S. Zolman and P.A. Fair. 2004. Geographic variation in polychlorinated biphenyl and organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. Sci. Total Environ. 319: 147-172.
- Hoelzel, A.R., C.W. Potter and P.B. Best. 1998. Genetic differentiation between parapatric nearshore and offshore populations of the bottlenose dolphin. Proc. Royal Soc. London 265: 1177-1183.
- Kenney, R.D. 1990. Bottlenose dolphins off the northeastern United States. pp. 369-386. In: S. Leatherwood and R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.
- Knoff, A.J. 2004. Bottlenose dolphin (*Tursiops truncatus*) population structure along the Atlantic coast of the United States: A stable isotope approach. Ph.D. Dissertation, University of Virginia, Charlottesville, VA, 156 pp.
- Kuehl, D.W., R. Haebler and C. Potter. 1991. Chemical residues in dolphins from the US Atlantic coast including Atlantic bottlenose obtained during the 1987/1988 mass mortality. Chemosphere 22: 1071-1084.
- Laake, J.L. and D.L. Borchers. 2004. Methods for incomplete detection at distance zero. pp. 108-189. In: S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.) Advanced distance sampling. Oxford University Press, New York.
- Litz, J.A., L.P. Garrison, L.A. Fieber, A. Martinez, J.P. Contillo and J.R. Kucklick. 2007. Fine-scale spatial variation of persistent organic pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida. Environ. Sci. Technol. 41: 7222-7228.
- Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1): 107-117.
- Mazzoil, M., J.S. Reif, M. Youngbluth, M.E. Murdoch, S.E. Bechdel, E. Howells, S.D. McCulloch, L.J. Hansen and G.D. Bossart. 2008. Home ranges of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida: Environmental correlates and implications for management strategies. EcoHealth 5: 278-288.
- Mead, J.G. and C.W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: Morphological and ecological considerations. IBI Reports 5: 31-44.

- McLellan, W.M., A.S. Friedlaender, J.G. Mead, C.W. Potter and D.A. Pabst. 2003. Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: Do historic records support the coastal migratory stock hypothesis? *J. Cetacean Res. Manage.* 4: 297-304.
- NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991.
- Noke, W.D. and D.K. Odell. 2002. Interactions between the Indian River Lagoon blue crab fishery and the bottlenose dolphin, *Tursiops truncatus*. *Mar. Mamm. Sci* 18(4): 819-832.
- Palka, D.L. and M.C. Rossman. 2001. Bycatch estimates of coastal bottlenose dolphin (*Tursiops truncatus*) in the U.S. mid-Atlantic gillnet fisheries for 1996 to 2000. Northeast Fisheries Science Center Reference Document 01-15. 77 pp.
- Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. *Ecol. Indicators* 18: 278–290.
- Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: Common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. *Mol. Ecol.* 18: 5030–5045.
- Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. *Env. Toxic. Chem.* 21: 2752-2764.
- Scott, G.P., D.M. Burn and L.J. Hansen. 1988. The dolphin die off: Long term effects and recovery of the population. *Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8, Vol. 3:* 819-823.
- Scott, M.D., R.S. Wells and A.B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. pp. 235-244. *In:* S. Leatherwood and R. R. Reeves (eds.) *The bottlenose dolphin*. Academic Press, San Diego, CA. 653 pp.
- Stolen, M.K., W.N. Durden and D.K. Odell. 2007. Historical synthesis of bottlenose dolphin (*Tursiops truncatus*) stranding data in the Indian River Lagoon system, Florida, from 1977-2005. *Fla. Sci.* 70: 45-54.
- Speakman, T., E.S. Zolman, J. Adams, R.H. Defran, D. Laska, L. Schwacke, J. Craigie and P. Fair. 2006. Temporal and spatial aspects of bottlenose dolphin occurrence in coastal and estuarine waters near Charleston, South Carolina. NOAA Tech. Memo. NOS-NCCOS-37, 243 pp.
- Thayer, V.G., D.M. Waples and A.J. Read. 2007. Monitoring bycatch in the North Carolina stop net fishery. Final report for NMFS Fisheries Research Grant, project WC133F05SE5050. Available from: NMFS, Southeast Fisheries Science Center, 3209 Frederic St., Pascagoula, MS 39568.
- Vollmer, N.L. 2011. Population structure of common bottlenose dolphins in coastal and offshore waters of the Gulf of Mexico revealed by genetic and environmental analyses. Ph.D. Dissertation from University of Louisiana at Lafayette. 420 pp.
- Wade, P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.
- Weller, D.W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation from Texas A&M University, College Station. 142 pp.
- Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. *Mar. Mamm. Sci.* 31(1): 355-368.
- Wells, R.S., M.D. Scott and A.B. Irvine. 1987. The social structure of free ranging bottlenose dolphins. pp. 247-305. *In:* H. Genoways (ed.) *Current Mammalogy*, Vol. 1. Plenum Press, New York. 519 pp.
- Wells, R.S., V. Tornero, A. Borrell, A. Aguilar, T.K. Rowles, H.L. Rhinehart, S. Hofmann, W.M. Jarman, A.A. Hohn and J.C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. *Sci. Total Environ.* 349: 106-119.
- Wells, R.S., K.W. Urian, A.J. Read, M.K. Bassos, W.J. Carr and M.D. Scott. 1996. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC- 385, 25 pp. + 6 Tables, 8 Figures, and 4 Appendices.
- Zolman, E.S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River Estuary, Charleston County, South Carolina. *Mar. Mamm. Sci.* 18: 879-892.

