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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Stock Structure of the Coastal Morphotype

A. Latitudinal distribution and structure along the coast

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, around the Florida peninsula and along the Gulf of Mexico coast. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Curry 1997; Duffield and Wells 2002). On the Atlantic coast, Scott *et al.* (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, NY, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-88 and observed density patterns. More recent studies indicate that the single coastal migratory stock hypothesis is incorrect, and there is a complex mosaic of stocks (NMFS 2001; McLellan *et al.* 2003).

Genetic analyses of samples from northern Florida, Georgia, central South Carolina (primarily the estuaries around Charleston), southern North Carolina, and coastal Virginia, using both mitochondrial DNA and nuclear microsatellite markers indicate that a significant amount of the overall genetic variation can be explained by differences between these areas (NMFS 2001). These results indicate a minimum of five stocks of coastal bottlenose dolphins along the US Atlantic coast and reject the null hypothesis of one homogeneous population.

Photo-identification studies also support the existence of multiple stocks (NMFS 2001). A coastwide photographic catalogue has been established using contributions from 15 sites from Cape May, NJ, to Cape Canaveral, FL (Urian *et al.* 1999). No matches have been found between the northernmost and southernmost sites. However, there appears to be a high rate of exchange among northern field sites, where dolphins occur only seasonally, and central North Carolina. Other areas of frequent exchange include Beaufort and Wilmington, NC. By comparison, the degree of movement along the southern portion of the Atlantic coast is poorly understood and is currently under study.

Satellite-linked radio transmitters have been deployed on dolphins off Virginia Beach, VA, Beaufort, NC, Charleston, SC and New Jersey. The movement patterns of animals with satellite tags provide additional information complementary to other stock identification approaches. The results, along with photo-identification of freeze-branded animals, indicate that a significant number of dolphins reside in North Carolina in summer and do not migrate. A dolphin tagged in Virginia Beach, VA, spent the winter between Cape Hatteras and Cape Lookout, NC, indicating seasonal migration between North Carolina and areas further north (NMFS 2001).

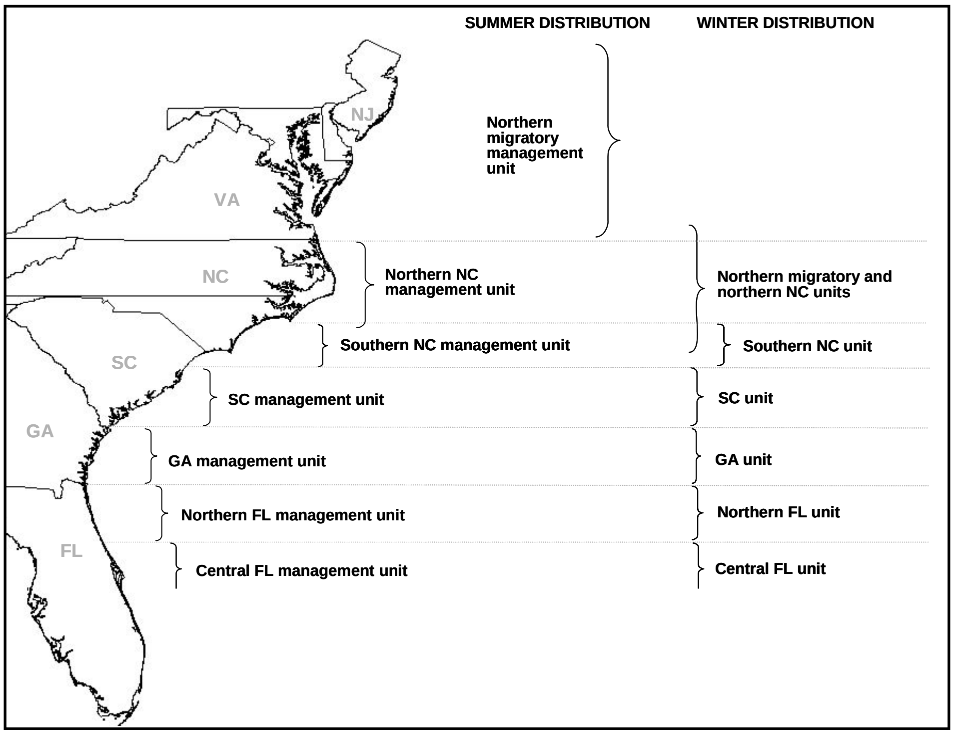
Another potential stock has been identified from stable isotope ratios of oxygen (NMFS 2001). Animals sampled along the beaches of North Carolina between Cape Hatteras and Bogue Inlet during February and March show very low stable isotope ratios of ^{18}O relative to ^{16}O (referred to as depleted ^{18}O or depleted oxygen, Cortese 2000). One possible explanation for the depleted oxygen signature is a resident group of dolphins in Pamlico Sound that move into nearby nearshore areas in the winter. The possibility of a resident group of bottlenose dolphins in Pamlico Sound is supported by results from satellite telemetry and photo-identification results. Alternatively, these animals may represent a component of the migratory animals that spend their summers at the northernmost end of the range of bottlenose dolphins and winter in North Carolina. Either possibility suggests that they represent a separate stock.

There are additional resident estuarine stocks that are likely demographically distinct from coastal stocks, and they are currently included in the coastal management unit definitions. For example, year-round resident populations have been reported at a variety of sites from Charleston, SC (Zolman 2002; Speakman *et al.* 2006) to central Florida (Odell and Asper 1990). Seasonal residents and migratory or transient animals also occur in these areas (summarized in Hohn 1997). In the northern part of the range, the patterns reported include seasonal residency, year-round residency with large home ranges, and migratory or transient movements (Barco and Swingle 1996). Long-term, year-round, multi-generational resident communities of dolphins have been recognized in embayments and coastal areas of the Gulf of Mexico (Wells *et al.* 1987; Wells *et al.* 1996; Scott *et al.* 1990; Weller

1998; Wells 2003), and it is not surprising to find similar patterns along the Atlantic coast.

Integration of the results from genetic, photo-identification, satellite telemetry, and stable isotope studies confirms a complex mosaic of coastal bottlenose dolphin stocks. Based upon available data and analysis, seven management units within the range of the coastal morphotype of western North Atlantic bottlenose dolphin have been defined (Figure 1). The true population structure is likely more complex than the seven units identified in this report, and research efforts continue to identify that structure.

Figure 1. Management units of the coastal morphotype of bottlenose dolphin along the Atlantic coast of the US as defined from genetic, stable isotope ratio, photo-identification, and telemetry studies (NMFS 2001).



B. Longitudinal distribution

Aerial surveys conducted between 1978 and 1982 (CETAP 1982) north of Cape Hatteras, North Carolina identified two concentrations of bottlenose dolphins, one inshore of the 25 m isobath and the other offshore of the 50m isobath. The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. It was suggested, therefore, that the coastal morphotype is restricted to waters < 25 m deep north of Cape Hatteras (Kenney 1990). Similar patterns were observed during summer months north of Cape Lookout, NC in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al.* 2003). However, south of Cape Lookout during both winter and summer months, there was no clear longitudinal discontinuity in bottlenose dolphin sightings (Garrison and Yeung 2001; Garrison *et al.* 2003).

Dolphin groups observed during aerial surveys cannot be attributed to a specific morphotype based on sighting information alone. Genetic analysis of tissue samples can be used to identify animals to a specific morphotype (Hoelzel *et al.* 1998; P. Rosel SEFSC unpublished results). An analysis of tissue samples from large vessel surveys during the summers of 1998 and 1999 indicated that bottlenose dolphins within 7.5 km from shore were most likely of the coastal morphotype, and there was an extensive region of overlap between the coastal and offshore morphotypes between 7.5 and 34 km from shore south of Cape Hatteras, NC (Torres *et al.* 2003). However, relatively few samples were available from the region of overlap, and therefore the longitudinal boundaries based on these initial analyses are uncertain (Torres *et al.* 2003). Extensive systematic biopsy sampling efforts were conducted in the summers of 2001 and 2002 to supplement collections from large vessel surveys. During the winters of 2002 and 2003, additional biopsy collection efforts were conducted in nearshore continental shelf waters of North Carolina and Georgia. A small number of additional biopsy samples were collected in deeper continental shelf waters south of Cape Hatteras during winter 2002. Genetic analyses of these biopsies identified individual animals to the coastal or offshore morphotype. Based upon the genetic results from all surveys combined, a logistic regression approach was used to model the probability that a particular bottlenose dolphin group is 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 overlapping 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. North of Cape Lookout, NC (i.e., northern migratory and northern North Carolina management units) during summer months, the previously observed pattern of strong nearshore aggregation of bottlenose dolphins was again observed. All biopsy samples collected from nearshore waters (< 20 m deep) were of the coastal morphotype and all samples collected in deeper waters (> 40 m deep) were of the offshore morphotype. The genetic results confirm separation of the two populations in this region during summer months. South of Cape Lookout, NC, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth; however, there was significant 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). These results indicate significant overlap between the two morphotypes in the southern management units during summer months.

Winter samples were collected primarily from nearshore waters in North Carolina and Georgia. The vast majority of samples collected in nearshore waters of North Carolina during winter were of the coastal morphotype; however, one offshore morphotype group was sampled during November just south of Cape Lookout, North Carolina only 7.3 km from shore. Coastal morphotype samples were also collected further 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 are highly uncertain due to limited sample sizes and high 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 well offshore at a distance of 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). There remain significant sampling gaps in the biopsy collections, particularly during winter months, that increase the uncertainty of model predictions. Both the predicted probability of a coastal morphotype occurring and the associated uncertainty in that prediction are incorporated into the abundance estimates for coastal morphotype bottlenose dolphin management units.

POPULATION SIZE

Previous abundance estimates for the coastal morphotype of WNA bottlenose dolphin were based primarily upon aerial surveys conducted during the summer and winter of 1995. The surveys were designed based upon the previous assumption of a single coastal migratory stock, and therefore they did not provide complete seasonal and spatial coverage for the more recently defined management units. Previous abundance estimates were also not corrected for visibility bias (Garrison and Yeung 2001). Aerial surveys to update the abundance estimates were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40 m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20 m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. Survey effort was also stratified to optimize coverage in seasonal management units. The surveys employed two observer teams operating independently on the same aircraft to estimate visibility bias.

The winter survey included the region from the Georgia/Florida state line to the southern edge of Delaware Bay. A total of 6,411 km of trackline was completed during the survey, and 185 bottlenose dolphin groups were sighted including 2,114 individual animals. No bottlenose dolphins were sighted north of Chesapeake Bay corresponding to water temperatures < 9.5 ºC. During the summer survey, 6,734 km of trackline were completed between Sandy

Hook, NJ and Ft. Pierce, FL. All tracklines in the 0-20 m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia-Florida state line. A total of 185 bottlenose dolphin groups was sighted during summer including 2,544 individual animals.

Abundance estimates for bottlenose dolphins in each management unit were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The independent and joint estimates from the two survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka 1995). These estimates were further partitioned between the coastal and offshore morphotypes based upon the results of the logistic regression models and spatial analyses described above. A parametric bootstrap approach was used to incorporate the uncertainty in the logistic regression models into the overall uncertainty in the abundance estimates for each management unit (Garrison *et al*. 2003).

The aerial surveys included only animals in coastal waters, and the resulting abundance estimates therefore do not include animals inside estuaries that are currently included in the defined management units. An abundance estimate was generated for bottlenose dolphins in estuaries from the North Carolina-South Carolina border to northern Pamlico Sound using mark-recapture methodology (Read *et al.* 2003), and these estimates were post-stratified to be consistent with management unit definitions (Palka *et al.* 2001a; Table 1). Since abundance estimates do not exist for all estuarine waters, the population estimates and PBRs for these management units are negatively biased.

Bottlenose dolphins in the northern migratory stock migrate south during winter months and overlap with those from the northern North Carolina and southern North Carolina management units. It is not possible at this time to apportion the incidental mortality occurring during winter months in North Carolina waters among animals from these three management units. Therefore, a half-year PBR value is applied for each management unit in the summer based upon abundance estimates from summer aerial surveys. During winter months, these three stocks overlap spatially and a half-year PBR is applied to the North Carolina mixed management unit based upon winter aerial survey abundance estimates. For the South Carolina and Georgia management units, the abundance estimates, minimum population size values, and the resulting PBR values are derived using a weighted average of abundance estimates from the winter and summer 2002 aerial surveys. The northern Florida management unit was only surveyed during the summer of 2002 and the winter of 1995. The resulting abundance estimate is therefore a weighted average of the seasonal estimates from the available surveys. Finally, the central Florida management unit was only covered during the 1995 surveys. Due to the age of the available abundance estimates, the PBR of the northern and central Florida management units were set to "undefined".

Table 1. Estimates of abundance and the associated CV, n_{min}, and PBR for each stock of WNA coastal bottlenose dolphins (Garrison *et al.* 2003). The PBR for the Northern Migratory, Northern NC, and Southern NC management units are applied semi-annually. South of NC, the PBR is applied annually. Except where noted, abundance estimates and PBR values do not include estuarine animals. The recovery factor (Fr) used to calculate PBR for each stock is based upon the CV of the mortality estimate based on the guidelines in Wade and Angliss (1997).

Unit		Best Abundance		N_{min}	Recovery Factor (Fr)	PBR	
		Estimate	CV			Annual	½ Yr
SUMMER (May - October)							
Northern migratory		17,466	0.19	14,621	0.50	(146.2)	73.1
Northern NC							
	oceanic	6,160	0.52	3,255	0.48	(31.2)	15.6
	estuary[a]	919	0.13	828	0.50	(8.2)	4.2
	BOTH	7,079	0.45	4,083	0.48	(39.2)	19.6
Southern NC							
	oceanic	3,645	1.11	1,863	0.40	(14.9)	7.5

	estuary[a]	141	0.15	124	0.50	(1.2)	0.6
	BOTH	3,786	1.07	1,987	0.40	(15.9)	7.9
WINTER (November – April)							
NC mixed[b]		16,913	0.23	13,558	0.50	(135.6)	67.8
ALL YEAR							
South Carolina		2,325	0.20	1,963	0.50	19.6	na
Georgia		2,195	0.30	1,716	0.50	17.2	na
Northern Florida[c,d]		448	0.38	unk	unk	unk	unk
Central Florida[d]		10,652	0.46	unk	unk	unk	unk

a. Read *et al.* 2003
b. NC mixed = northern migratory, Northern NC, and Southern NC
c. Northern Florida estimates are a weighted mean of abundance estimates from the winter 1995 survey and the summer 2002 survey. Due to the age of the winter abundance estimate, PBR cannot be calculated for this stock.
d. Northern and Central Florida estimates include data from the winter 1995 survey and cannot be used to determine PBR due to their age.

Minimum Population Estimate

The minimum population size (Nmin) for each stock was calculated as the lower bound of the 60% confidence interval for a lognormally distributed mean (Wade and Angliss 1997). For the estimates derived from bootstrap resampling, the appropriate Nmin was taken directly from the bootstrap distribution of abundance estimates. These estimates are negatively biased because they do not include estuarine animals other than those inside estuaries of North Carolina (Read *et al.* 2003), and they do not fully account for visibility bias. Minimum population sizes for each stock are shown in Table 1.

Current Population Trend

There are insufficient data to determine the population trend for these stocks.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the WNA 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 (Wade and Angliss 1997). This complex of management units incorporates the range of the former WNA coastal migratory stock that was defined as depleted under MMPA guidelines. At least some of these management units are likely depleted relative to their optimum sustainable population (OSP) size due both to mortality during the 1987-1988 die-off and high incidental mortality in fisheries. Given the known population structure within the coastal morphotype bottlenose dolphins, it is appropriate to apply PBR separately to each management unit so as to achieve the goals of the MMPA (Table 1; Wade and Angliss 1997).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Total estimated average annual fishery related mortality during 2001-2005 was 61 bottlenose dolphins (CV= 0.15) in the mid-Atlantic coastal gillnet fishery. The management units affected by this fishery are the northern migratory, northern North Carolina, and southern North Carolina management units. An estimated 5 (CV = 0.53) mortalities occurred annually in the shark drift gillnet fishery off the coast of Florida during 2001-2005, affecting the Central Florida management unit. No observer data are available for other fisheries that may interact with WNA coastal bottlenose dolphins. In addition, there are no estimates of fishery or other human cause mortality for animals residing inside estuaries. Therefore, the total average annual mortality estimate is a lower bound of the actual annual human-caused mortality for each stock. Detailed fishery information is presented in Appendix III.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental bycatch of marine mammals, was established in 1977 with the implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA).

Stranding data for 1993-1997 document interactions between WNA coastal bottlenose dolphins and pound nets in Virginia. Two bottlenose dolphin carcasses were found entangled in the leads of pound nets in Virginia during 1993-1997, an average of 0.4 bottlenose dolphin strandings per year. A third record of an entangled bottlenose dolphin in Virginia in 1997 may have been associated with this fishery. This entanglement involved a bottlenose dolphin carcass found near a pound net with twisted line marks consistent with the twine in the nearby pound net lead rather than with monofilament gillnet gear.

One bottlenose dolphin was recovered dead from a shrimp trawl in Georgia in 1995 (Southeast USA Marine Mammal Stranding Network unpublished data), and another was taken in 1996 near the mouth of Winyah Bay, SC, during a research survey. No other bottlenose dolphin mortality or serious injury has been reported to NMFS. There has been very little systematic observer coverage of this fishery during the last decade.

The Atlantic menhaden purse seine fishery historically reported an annual incidental take of 1 to 5 bottlenose dolphins (NMFS 1991, pp. 5-73). However, no observer data are available, and this information has not been updated for some time.

Mid-Atlantic Gillnet

This fishery has the highest documented level of mortality of WNA coastal morphotype bottlenose dolphins, and the North Carolina sink gillnet fishery is its largest component in terms of fishing effort and observed takes. Of 12 observed mortalities between 1995 and 2000, 5 occurred in sets targeting spiny or smooth dogfish and another in a set targeting “shark” species, 2 occurred in striped bass sets, 2 occurred in Spanish mackerel sets, and the remainder were in sets targeting kingfish, weakfish, or finfish generically (Palka and Rossman 2001). Only two bottlenose dolphin mortalities were observed in 2001-2002, both occurring in the winter mixed North Carolina unit. Two additional mortalities were observed in the northern North Carolina management unit in 2003 and 2004. The overall estimated level of mortality has declined during the past five years associated with reductions in fishery effort and reduced observed bycatch (Rossman in review). Due to these significant changes in the behavior of the fishery, bycatch estimates for these fisheries are separated into two periods: 1996 to 2000 and 2001 to 2005 (Table 2). Bycatch rate estimates for the 2001-2005 period are based solely on observed takes during 2001 and 2002. Estimates of total mortality for 2003-2005 are based upon fishery effort reported during those years.

Table 2. Summary of the 1996-2005 incidental mortality of bottlenose dolphins (*Tursiops truncatus*) by management unit in the commercial mid-Atlantic coastal gillnet fisheries. Data include the years sampled (Years), the number of vessels active within the fishery (Vessels), type of data used (Data Type), observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Seasonal Management Unit	Years	Vessels	Data Type[a]	Observer Coverage [b]	Observed Serious Injury	Observed Mortality	Estimated Mortality[d]	Estimated CVs [c]	Mean Annual Mortality
Summer Northern Migratory			Obs. Data, NER Dealer Data	.05, .03, .02, .03, .03,	0, 0, 0, 0, 0	0, 0, 1, 1, 1,	33, 30, 37, 19, 30,	0.48, 0.48, 0.48, 0.48, 0.48	30 (0.22)
	2001-2005			.02, .01, .03, .03, .05	0, 0, 0, 0, 0	0, 0, 0, 0, 0	11, 11, 17, 14, 20	0.35, 0.35, 0.35, 0.35, 0.35	15 (0.16)
Summer Northern NC			Obs. Data, NCDMF Dealer Data	.01, 0, <.01, .01, .03,	0, 0, 0, 0, 0	1, 0, 0, 0, 0,	27, 33, 17, 13, 26,	0.61, 0.61, 0.61, 0.61, 0.61	23 (0.29)
	2001-2005			.01, <.01, .01, .02, .,01	0, 0, 0, 0, 0	0, 0, 1, 0, 1	8, 8, 8, 7, 12	1.06, 1.06, 0.82, 0.82, 0.82	9 (0.41)
Summer Southern NC			Obs. Data, NCDMF Dealer Data	0, 0, .01, .03, .03,	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	NA	0 (NA)
	2001-2005			.02, <.01, 0, 0, 0	0, 0, unk, unk, unk	0, 0, unk, unk, unk	0, 0, unk, unk, unk	NA	unk (NA)
Winter NC mixed			Obs. Data, NCDMF Dealer Data	.01, .01, .02, .02, .02,	0, 0, 0, 0, 0	1, 0, 1, 2, 2,	173, 211, 175, 196, 146,	0.46, 0.46, 0.46, 0.46, 0.46	180 (0.21)
	2001-2005			.01, .01, .02, .03, .03	0, 0, 0, 0, 0	0, 2, 0, 0, 0	67, 50, 23, 30, 18	0.45, 0.45, 0.40, 0.40, 0.40	37 (0.22)
Total	2001-2005 Only								61 (0.15)

NA=Not applicable, unk = unknown or unobserved

a Observer data (Obs. data) are used to measure bycatch rates; the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. The NEFSC collects weighout landings data that are used as a measure of total effort for the sink gillnet fisheries.

b The observer coverage for the mid-Atlantic coastal sink gillnet fishery is measured as a proportion of the tons of fish landed.

c The annual estimates of mortality are computed by summing mortality estimates over six strata for each management unit. Stratified bycatch rates are estimated by a generalized linear model (Palka and Rossman 2001). An aggregate weighted CV is then calculated by weighting the stratified bycatch rates and variances by the proportion of observed metric tons sampled within each stratum. The CV does not account for variability that may exist in the unit of total landings (mt) from each year that are used to expand the bycatch rate.

d The annual estimates of mortality from 2001-2002 were generated by applying the same method used in Palka and Rossman (2001) with a new factor variable added to the model to separate the time series of historical data (1996-2000) from data collected during the recent time period (2001-2002) (Rossman in review). Until further model development is completed, mortality estimates for 2003 through 2005 were calculated by applying the bycatch rates from the recent time period (2001-2002) to effort from 2003 to 2005.

South Atlantic Shark Drift Gillnet

Observed takes of bottlenose dolphins occurred primarily during winter months when the fishery operates in waters off of southern Florida. Fishery observer coverage outside of this time and area has increased significantly in the last several years, and there was one observed mortality during summer months in fishing operations off Cape Canaveral, FL. There have been no observed interactions with bottlenose dolphins since 2003 (Carlson and Betha, 2006). All observed fishery takes are restricted to the Central Florida management unit of coastal bottlenose dolphin. Total bycatch mortality has been estimated for 2001-2005 following methods described in (Garrison 2003, Table 3).

Table 3. Summary of the 2001-2005 incidental mortality of bottlenose dolphins (*Tursiops truncatus*) by management unit in the driftnet fishery in federal waters off the coast of Florida. Data include years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), annual observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Seasonal Management Unit	Years	Vessels	Data Type [a]	Observer Coverage [b, c]	Observed Serious Injury	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northern Florida	2001-2005	6	Obs. Data, SEFSC FVL	.07, .20, .05, .10, unk[c]	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	NA	0
Central Florida	2001-2005	6	Obs. Data, SEFSC FVL	.42, .25, .09, .19, .26[c]	0, 0, 0, 0, 0	4, 1, 2, 0, 0	4, 7, 13, 0, 0	0, 1, .81, NA, NA	5 (.53)

unk = unknown, NA = cannot be calculated

a Observer data are used to estimate bycatch rates. The SEFSC Fishing Vessel Logbook (FVL) is used to estimate effort as total number of vessel trips per bottlenose dolphin management unit.

b Observer coverage in the central Florida management unit approaches 100% during the period between January - March south of 27° 51’ N latitude.

c During 2005, the number of observed sets exceeded the number of sets reported to the FVL system for specific areas and seasons within the central Florida management unit, therefore the true effort level is unknown. Estimates of effort are problematic for this fishery because logbook data does not distinguish between types of fishing sets including sink, drift, and strike gillnets sets.

Beach Haul Seine

Two coastal bottlenose dolphin takes were observed in the mid-Atlantic beach haul seine fishery: 1 in May 1998 and 1 in December 2000.

Crab Pots

Between 1994 and 1998, 22 bottlenose dolphin carcasses (4.4 dolphins per year on average) recovered by the Stranding Network between North Carolina and Florida’s Atlantic coast displayed evidence of possible interaction with a trap/pot fishery (i.e., rope and/or pots attached, or rope marks). Additionally, at least 5 dolphins were reported to be released alive (condition unknown) from blue crab traps/pots during this time period. During 2003, two bottlenose dolphins were observed entangled in crab pot lines in South Carolina, including one confirmed mortality, and two bottlenose dolphins were disentangled alive from crab pots in Virginia. In 2004, the SER stranding network reported observing 3 bottlenose dolphins (including one mortality) entangled in crab pot lines in Florida, one in Georgia, and three in South Carolina. In 2005, one entanglement was observed in Florida, one in Georgia, and one in Virginia. With the exception of the mortality in Florida during 2004, all animals were released from entangling gear and were not described to be seriously injured (SER Stranding Network). A review of stranding network data from South Carolina between 1992-2003 indicated that 24% of known bottlenose dolphin entanglements could be confirmed as involving crab pots, and an additional 19% of known entanglements were probable interactions with crab pots (Burdett and McFee 2004). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab pots. However, it is clear that this interaction is a common occurrence and does result in mortalities of coastal morphotype bottlenose dolphins.

Virginia Pound Nets

Stranding data for 2002-2005 indicate interactions between coastal bottlenose dolphins and pound nets in Virginia. Fifteen dolphins were removed dead from pound nets and 4 were disentangled and released alive. Additionally, 17 animals stranded with twisted twine line marks consistent with nearby pound net lead (SER Stranding Network)

Other Mortality

From 1997 to 2002, 1,967 bottlenose dolphins were reported stranded along the Atlantic coast from New York to Florida (Hohn and Martone 2001; Hohn *et al.* 2001; Palka *et al.* 2001b, Northeast Regional Stranding Program, Southeast Regional Stranding Program). Between 2003 and 2005, 935 bottlenose dolphins stranded along the Atlantic coast from New York to Florida (Table 4). Of these, it was possible to determine whether or not a human interaction had occurred for 449 (48%); for the remainder it was not possible to make that determination. Of those cases where an evaluation was possible, 32% of the carcasses had evidence of fisheries interaction; however, it should be noted that this was not necessarily the cause of death. This proportion was highest for Virginia (56%) and North Carolina (38%). 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.

There have been occasional mortalities of bottlenose dolphins during research activities including both directed live capture studies and fisheries surveys. In March 2002, a dolphin was entangled in the lazy line of a turtle relocation trawl off of Bogue Banks, North Carolina. In August 2002, a dolphin died during a fisheries research project using a trammel net in South Carolina (NMFS Protected Resources Division). Similarly, in March and November 2004, three dolphin mortalities occurred, including a mother-calf pair during a fisheries research project using a Trammel net in Georgia (SER Stranding Network). During 2004, one female bottlenose dolphin died during a health assessment capture study in Charleston, SC (NMFS Protected Resources Division). In July and October 2006, two mortalities occurred during a fisheries research project using trawl gear in South Carolina and North Carolina (SER Stranding Network). Two bottlenose dolphins tagged with an experimental transmitter package deployed during a NMFS research program off North Carolina died within several weeks of tagging during spring 2006 (NMFS Protected Resources Division).

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 1987-88 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 tissues from several estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly near Charleston, SC and Beaufort, NC (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). While there are no direct measurements of adverse effects of pollutants on estuarine dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

Table 4. Summary of bottlenose dolphins stranded along the Atlantic Coast of the US. Total Stranded is further stratified into carcasses with signs of human interaction, those without any signs, and those where human interaction could not be determined (CBD). Human Interaction is stratified into stranded animals with line or nets marks or gear attached (Fishery Interaction), and other indications of human interactions such as propeller wounds, mutilation, or gunshot wounds. Florida strandings include only the Atlantic coast of Florida extending to Key West.

STATE	2003	2004	2005	STATE	2003	2004	2005
New York Total Stranded	**2**	**0**	**0**	**N. Carolina** Total Stranded	**69**	**89**	**78**
Human Interaction				Human Interaction			
---- Fishery Interaction	0	0	0	---- Fishery Interaction	11	15	9
---- Other	0	0	0	---- Other	0	1	3
No Human Interaction	1	0	0	No Human Interaction	16	22	14
CBD	1	0	0	CBD	42	51	52
New Jersey Total Stranded	**7**	**15**	**13**	**S. Carolina** Total Stranded	**35**	**46**	**38**
Human Interaction				Human Interaction			
---- Fishery Interaction	1	1	0	---- Fishery Interaction	3	3	5
---- Other	0	1	0	---- Other	0	3	0
No Human Interaction	5	11	7	No Human Interaction	17	22	17
CBD	1	2	6	CBD	15	18	16
Delaware Total Stranded	**18**	**16**	**9**	**Georgia** Total Stranded	**17**	**27**	**14**
Human Interaction				Human Interaction			
---- Fishery Interaction	1	1	1	---- Fishery Interaction	0	3	2
---- Other	0	0	0	---- Other	0	1	0
No Human Interaction	13	11	1	No Human Interaction	2	9	2
CBD	4	4	7	CBD	15	14	10
Maryland Total Stranded	**10**	**10**	**4**	**Florida** Total Stranded	**74**	**81**	**68**
Human Interaction				Human Interaction			
---- Fishery Interaction	1	1	1	---- Fishery Interaction	11	7	6
---- Other	0	0	0	---- Other	0	2	2
No Human Interaction	8	6	0	No Human Interaction	21	27	14
CBD	1	3	3	CBD	42	45	46
Virginia Total Stranded	**60**	**75**	**60**	**Total**	**292**	**359**	**284**
Human Interaction							
---- Fishery Interaction	25	22	13				
---- Other	0	2	0				
No Human Interaction	12	13	20				
CBD	23	38	27				

STATUS OF STOCKS

The coastal migratory stock was designated as depleted under the MMPA. From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the WNA, and the entire stock was listed as depleted. The management units in this report replace the single coastal migratory stock. It should be noted that dolphins residing in a number of bays, sounds, and estuaries in the mid-Atlantic region adjacent to the named stocks are included in these stocks, but for the most part they have not been assessed and are not included in the reported abundance, mortality, and PBR estimates. Since one or more of the management units may be depleted, all management units retain the depleted designation. Mortality exceeded PBR in the North Carolina winter mixed stocks during the period from 1996 to 2000. However, due to recent declines in fishery effort and apparent declines in bycatch rates, estimated fishery mortality does not exceed PBR for any of the stocks (Table 1). It should be noted that the gillnet fishery effecting the summer southern North Carolina management unit has not been observed in recent years, and the impact of entanglements with crab pots in Georgia and South Carolina is unknown. The total U.S. fishery-related mortality and serious injury for most stocks is not less than 10% of the calculated PBR, and thus cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The species is not listed as threatened or endangered under the Endangered Species Act, but the management units are strategic stocks due to the depleted listing under the MMPA.

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