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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data).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

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 The borders are delineated primarily on the basis of available estuarine habitat and telemetry data (NMFS unpublished data) suggesting a break in movement of bottlenose dolphins north and south of the Beaufort Inlet area.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

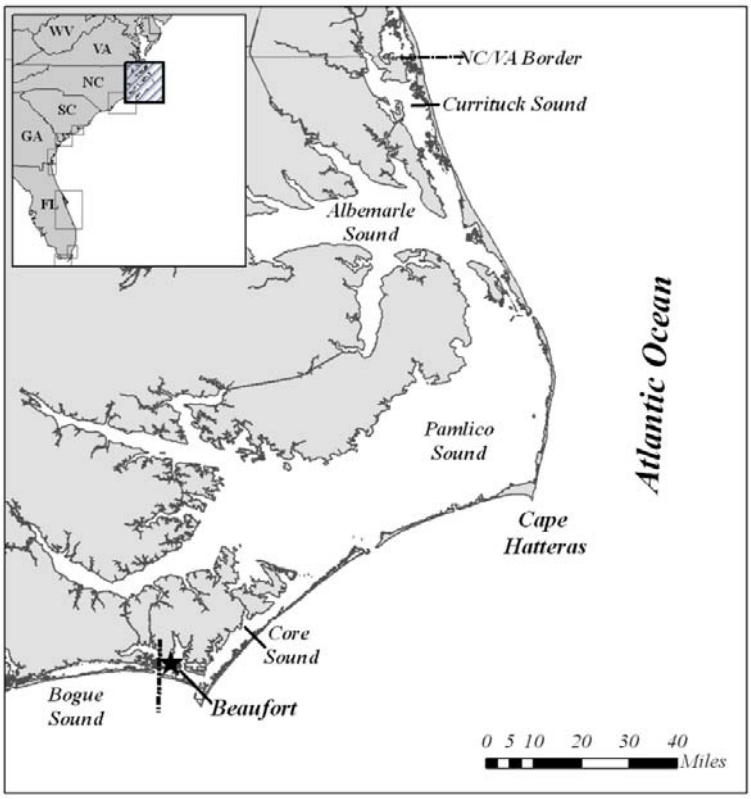

Figure 1. *Geographic extent of the Northern North Carolina Estuarine System (NNCES) stock, located on the coast of North Carolina. The borders are denoted by dashed lines.*

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

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

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

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

POPULATION SIZE

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

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). Because the only available comprehensive abundance for this stock (from Read *et al.* 2003) was derived from data that are more than 8 years old, they may not be used to calculate the minimum population estimate, and as a result the minimum population estimate for the NNCES stock of bottlenose dolphins is unknown. The lowest seasonal estimate provided by Goodman *et al.* (2007) could be used, but that estimate is for 25% or less of the stock's range and is likely unrealistically low. The large variation in the Goodman *et al.* (2007) estimates could indicate that the sampling methodology was inappropriate for estimating abundance or that the movements of animals within the stock's range, both into and out of the sampling area, resulted in the variation. A new estimate of abundance based on photo-ID mark-recapture studies will be forthcoming (Read, pers. comm.).

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Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the NNCES stock of bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for this stock of bottlenose dolphins is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

Fishery Information

The NNCES stock interacts with 4 Category II fisheries: the Atlantic blue crab trap/pot fishery, North Carolina long haul seine fishery, mid-Atlantic haul/beach seine fishery and North Carolina inshore gillnet fishery. There is no systematic observer coverage of these fisheries by the National Marine Fisheries Service (NMFS), although the North Carolina Division of Marine Fisheries operates systematic coverage of the fall flounder gillnet fishery in Pamlico Sound (Price 2008). As a result, information about interactions with North Carolina inshore fisheries is based solely on stranding data and it is not possible to estimate the annual number of interactions or mortalities in these fisheries. The NNCES stock may also interact with the mid-Atlantic gillnet fishery, but estimates of the potential for this interaction will not be known until the various datasets on spatial distribution mentioned above are integrated and analyzed.

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

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

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

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

Other Mortality

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

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

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

STATUS OF STOCK

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

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

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

The Southern North Carolina Estuarine System (SNCES) stock is bounded in the south by the border between North Carolina and South Carolina and in the north by the Beaufort Inlet, and encompasses all estuarine waters in between, including but not limited to the Intracoastal Waterway, the Cape Fear River and tributaries, Bogue Sound and tributaries, and the White Oak and New Rivers. The borders are based primarily on a photo-ID study area (Read *et al.* 2003) and are subject to change upon further study of dolphin residency patterns in estuarine waters of North Carolina and northern South Carolina. Estuarine animals residing within the SNCES were previously included in stock assessment reports for the Western North Atlantic Coastal Morphotype Stocks of bottlenose dolphins (e.g., Waring *et al.* 2009). Dolphins residing in the estuaries south of this stock between the North Carolina/South Carolina border and the northern boundary of the Charleston Estuarine System stock (CES) are not currently covered in any stock assessment report. There are insufficient data to determine whether animals in this region exhibit affiliation to the CES stock or to the SNCES stock, or if there are 1 or more estuarine stocks in this region. It should be noted, however, that in this intervening region during 2003-2007, there were 11 recorded bottlenose dolphin strandings, 2 of which were confirmed fishery interactions. One of these 2 was entangled in crab pot gear, disentangled and released alive. Of the remaining 9 stranded dolphins, evidence of human interaction could not be determined for 4 and 5 were determined not to have had any human interaction.

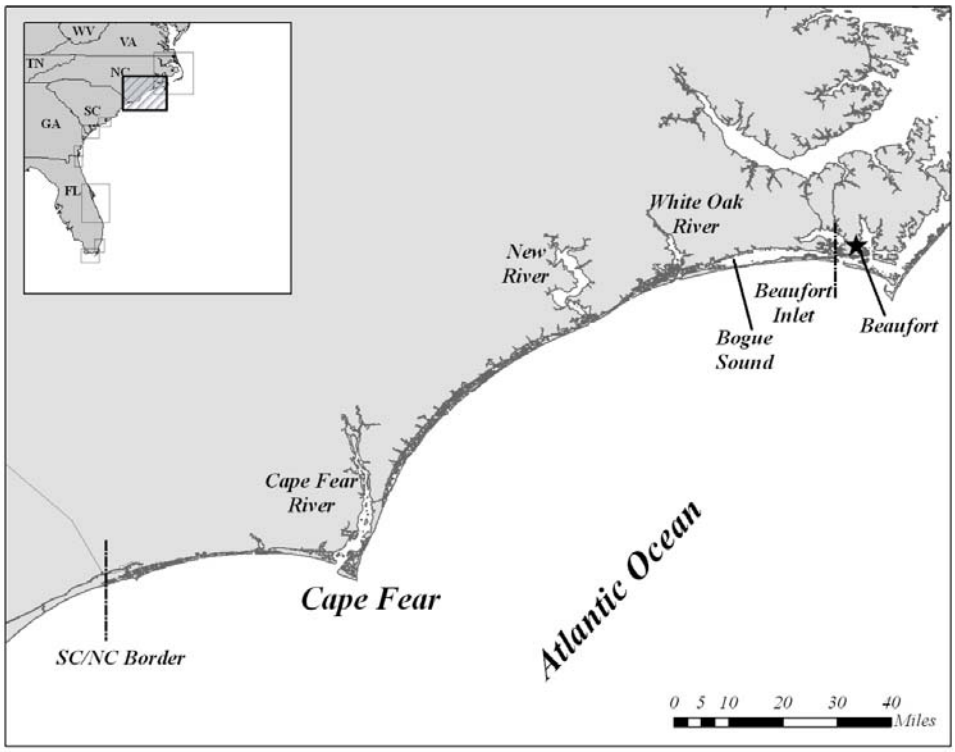

Figure 1. *Geographic extent of the Southern North Carolina Estuarine System (SNCES) stock, located on the coast of North Carolina. The borders are denoted by dashed lines.*

The SNCES stock has been defined as an estuarine stock primarily by the results of photo-ID studies. Long-term photo-ID studies have identified numerous individuals that occur regularly both near and in the Cape Fear River, in the estuarine waters near Beaufort, and in estuarine waters and along ocean-front beaches between the Cape Fear River and Beaufort (Urian *et al.* 1999; Urian pers. comm.). Read *et al.* (2003) conducted a photo-ID study in the estuarine waters of North Carolina during July 2000 and suggested that, based on the patterns of resights, differences in group sizes, and habitat, there may be a northern stock and southern stock in North Carolina estuarine waters, with the stock boundary near Beaufort, North Carolina.

Limited telemetry data lend support to the boundary definition of the SNCES stock (Read *et al.* 1996; NMFS unpublished data). Four animals captured, fitted with satellite-linked telemetry, and released near Cape Fear, North Carolina, in November 2004 displayed 3 movement patterns: 1) 2 animals were clearly not of the estuarine stock, and occurred exclusively in coastal waters from Florida to Virginia (tag duration 221 and 251 days); 2) 1 animal occurred in estuarine and coastal waters from the Cape Fear River to Beaufort (tag duration 94 days), a pattern also evident in multi-year photo-ID data for this animal; and 3) 1 animal occurred primarily in the Cape Fear River and coastal waters near the Cape Fear River inlet (tag duration 322 days) (NMFS unpublished data). The information on these last 2 animals suggests 2 possible stock distribution patterns; 1 that encompasses estuarine and coastal waters between the Cape Fear River and Beaufort, and another that is restricted to estuarine waters of the Cape Fear River and nearby coastal waters. Radio-tracking of dolphins tagged in Bogue Sound, North Carolina, and in the vicinity of Beaufort, North Carolina, in 1995 showed movements consistent with photo-ID findings (Read *et al.* 1996).

Photo-ID studies have shown that some animals move between the estuaries in and around Beaufort south to the Cape Fear River and nearby waters, and some move from Beaufort north into Pamlico Sound and adjacent waters (Urian *et al.* 1999; Urian, pers. comm.; NMFS unpublished data), and telemetry data showed that animals moved between Beaufort and Pamlico Sound (NMFS unpublished data). This overlap near the Beaufort area could suggest that there is only 1 stock that includes estuarine waters from the North Carolina/South Carolina border to the North Carolina/Virginia border. However, the telemetry and photo-ID studies indicate that there is little, if any significant movement of animals from 1 area to the other, for instance, from Cape Fear to Pamlico Sound. The available information does not provide consistent, year-round coverage so it is possible that there may be seasonal variability in distribution patterns that may conflict with this stock definition.

The telemetry studies and the photo-ID studies show that while most of locations where animals of the SNCES stock have been observed were in estuarine waters, at least some of the animals do occur in coastal waters. A variety of existing datasets with information on spatial distribution patterns of this stock may be useful for accurately quantifying its usage of coastal waters, and the integration and analyses of those data have been initiated. Information on use of coastal waters will be important when considering exposure to coastal fisheries as estuarine animals that make use of nearshore coastal waters would be at risk of entanglement in fishing gear while moving along the coast.

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Population size estimates for this stock are greater than 8 years old and therefore the current population size for the stock is considered unknown (Wade and Angliss 1997). Read *et al.* (2003) provided the first and only available comprehensive abundance estimate of bottlenose dolphins that occur within the proposed boundaries of the SNCES stock. This estimate is based on a photographic mark-recapture survey of North Carolina waters inshore of the barrier islands, conducted during July 2000. Read *et al.* (2003) estimated the number of animals in the inshore waters of North Carolina equivalent to that of the SNCES stock at 141 (95% CI 112 - 200, CV=0.15).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). Because the only available abundance estimate for this stock was derived from data that are more than 8 years old, they may not be used to calculate the minimum population estimate, and as a result the minimum population estimate for the SNCES stock of bottlenose dolphins is unknown. A new estimate of abundance based on photo-ID capture-recapture studies will be forthcoming (Read, pers. comm.).

Current Population Trend

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

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Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate

was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

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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 SNCES stock of bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for this stock of bottlenose dolphins is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

Fishery Information

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

From 2003 through 2007, 19 bottlenose dolphins were found stranded or entangled in gear within the SNCES area (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). Of these, it was possible to determine whether or not a human interaction (HI; e.g., gear and debris entanglement, mutilation, boat collision) had occurred for 10 (52.6%); for the remainder it was not possible to make that determination due primarily to decomposition. Three of the 10 strandings were categorized as 'yes' for evidence of human interactions, all of which were determined to have been involved in a fisheries interaction (FI) based on direct observation of entanglement or by entanglement lesions (Read and Murray 2000). One of them was seen alive and entangled in monofilament line. This animal was captured to remove the line, but it died during the capture. The condition of the entanglement and the necropsy afterwards indicated that the animal's health was severely complicated by the entanglement and that survival of the injuries without intervention was unlikely (NMFS unpublished data). Of the remaining 2 FI strandings, 1 had healed lesions that were unlikely to have contributed to its death. The other FI stranding had entanglement lesions consistent with entanglement in multifilament webbing. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fisheries are discovered, reported, or investigated, nor will all of those that are found necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

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

Stock	Category	2003	2004	2005	2006	2007	Total
SNCES	Total Stranded	3	5	4	3	4	19
	Human Interaction						
	---Fishery Interaction	0	0	2	0	1	3
	---Other	0	0	0	0	0	0
	No Human Interaction	1	4	0	1	1	7

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CBD	2	1	2	2	2	9

Other Mortality

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

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

STATUS OF STOCK

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

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

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*)
Charleston Estuarine System Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Except for animals residing within the Southern North Carolina and Northern North Carolina Estuarine Systems (e.g., Waring *et al.* 2007), estuarine dolphins along the U.S. east coast have not previously been included in stock assessment reports. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several areas (Caldwell 2001; Gubbins 2002a; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Balmer *et al.* in press). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005).

The Charleston Estuarine System (CES) stock is centered near Charleston, South Carolina. It is bounded in the north by Price Inlet and includes a stretch of the Intracoastal Waterway (ICW) approximately 13 km east-northeast of Charleston Harbor. It continues through Charleston Harbor and includes the main channels and selected creeks of the Ashley, Cooper and Wando Rivers. The CES stock also includes the Stono River Estuary, approximately 20 km south-southwest of Charleston Harbor, the North Edisto River another 20km to the west-southwest, and the estuarine waters and tributaries of these rivers (Figure 1). The southern boundary abuts the northern boundary of the Northern Georgia/Southern South Carolina Estuarine System stock, previously defined based on a photo-ID project (Gubbins 2002a; b; Gubbins 2002c). The borders of this region are defined based on long-term photo-ID studies and telemetry work (Speakman *et al.* 2006; Adams *et al.* 2008). The CES stock boundaries are subject to change upon further study of dolphin residency patterns in estuarine waters of North Carolina, South Carolina and Georgia.

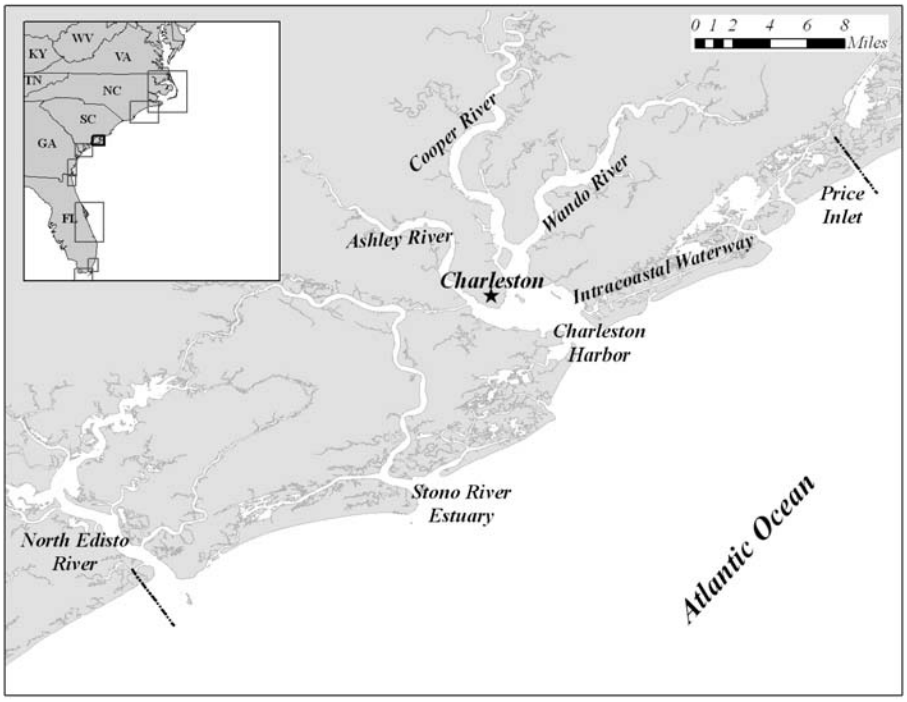

Figure 1. *Geographic extent of the Charleston Estuarine System (CES) stock. Dashed lines denote the boundaries.*

The Ashley, Cooper and Wando Rivers and the Charleston Harbor are characterized by a high degree of land development and urban areas whereas the Stono River Estuary and North Edisto River have a much lower degree of development. The Charleston Harbor area includes a broad open water habitat, while the other areas consist of river

channels and tidal creeks. The ICW area consists of miles of undeveloped salt marshes, and it has the least amount of open water habitat.

Using photo-ID data, Speakman *et al.* (2006) considered a dolphin to be a resident to the area if it was observed during all 4 seasons, regardless of year. Seasonal residents were defined as those observed during the same season in consecutive years, but not in intervening seasons, while transients were only observed during 1 season or in 2 consecutive seasons. It is thought that the seasonal residents and transients may be coastal animals that occasionally or seasonally use estuarine habitats. There is evidence from photo-ID studies that resident dolphins in this stock may also use the coastal waters to move between areas, but that resident estuarine animals are distinct from animals that reside in coastal waters or use coastal waters during seasonal migrations (Speakman *et al.* 2006).

Zolman (2002) analyzed photo-ID data collected in the Stono River Estuary from October 1994 through January 1996 and identified a number of year-round resident dolphins using this area. Zolman (2002) indicated the likelihood that the Stono River Estuary included the entire home range of a dolphin was small, as individual resident dolphins were observed in other areas, including the North Edisto River and Charleston Harbor.

Speakman *et al.* (2006) summarized studies carried out from 1994-2003 on bottlenose dolphins throughout the CES, incorporating the above studies. Individual identifications were made for 839 dolphins, with 115 (14%) sighted between 11 and 40 times. Eighty-one percent (81%) of the 115 individuals were sighted over a period exceeding 5 years while 44% were sighted over a period of 7.7-9.8 years, suggesting long-term residency for some of the dolphins in the CES stock. Using adjusted sighting proportions to correct for unequal survey effort, 42% of the dolphins showed a strong fidelity for a particular area. Among the individuals sighted at least once in the coastal area, 3% were seen only in the coastal area, 62% were seen in the coastal and one other area, 27% were seen in 2 other areas and 8% were seen in 3 additional areas. This finding, that 97% of the dolphins with high sighting frequencies were observed in at least 2 areas, supports the inclusion of the entire CES as 1 stock, as opposed to multiple stocks (Speakman *et al.* 2006). The number of dolphins observed in Charleston Harbor was 50% greater than in the Stono River Estuary, at least 40% higher than in the North Edisto River and approximately 9 times greater than in the ICW, illustrating that Charleston Harbor is a high use area for this stock (Speakman *et al.* 2006).

Telemetry studies of bottlenose dolphins in this area followed 2 females from October 1999 to January 2000 (Hansen, pers. comm.; NOAA/NOS/NCCOS unpublished data). One female was captured and tagged in the Stono River Estuary along with her dependent calf. She moved briefly to Charleston Harbor then to the North Edisto River before returning to the Stono River Estuary. The second female was also captured and tagged in the Stono River Estuary and moved frequently between this estuary and Charleston Harbor. These results illustrate the connective nature of the areas within the Charleston region.

Dolphins are known to reside in the estuaries north of this stock between Price Inlet, South Carolina, and the North Carolina/South Carolina border, and are not currently covered in any stock assessment report. During surveys in August 1999, a group of 25-30 dolphins consistently occupied Winyah Bay, South Carolina, with 5 individuals resighted multiple times (Young and Phillips 2002). Treating the North Inlet and Winyah Bay as a closed population, mark recapture analyses yielded a population estimate of 47.4 (95% confidence interval of 39.0-60.6). Sloan (2006) surveyed the Cape Romaine National Wildlife Refuge area from September 2003 through August 2005 and identified 22 year round residents, 49 seasonal residents and 50 transient dolphins. Petricig (1995) also documented year-round residents in the estuarine waters of Bull Creek. There are insufficient data to determine whether animals in this region exhibit affiliation to the CES stock or to the stock to the north, the Southern North Carolina Estuarine System stock, or should be delineated as their own stock(s). Further research is needed to establish affinities of dolphins in this region. It should be noted, however, that in this intervening region during 2003-2007, there were 11 recorded bottlenose dolphin strandings, 2 of which were confirmed fishery interactions. One of these 2 was entangled in crab pot gear, disentangled and released alive. Of the remaining 9 stranded dolphins, it could not be determined if there was evidence of human interactions for 4 animals, and no evidence of human interactions was found for 5 animals.

POPULATION SIZE

The total number of bottlenose dolphins residing within the CES stock is unknown. Since 1994, 839 dolphins have been identified in 5 areas of the CES by Speakman *et al.* (2006). This number includes dolphins that are in the coastal morphotype stock and are transients or seasonal residents to this area, as opposed to the estuarine dolphins found in the rivers and marshes of the CES. Therefore a population size cannot be determined from this study. Analyses to calculate abundance estimates from 2004-2006 mark-recapture analyses, which will yield seasonal, if not annual, abundance estimates for this stock, are being conducted by NOAA/NOS/NCCOS.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate for the Charleston Estuarine System stock of bottlenose dolphins.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the CES stock of bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for this stock of bottlenose dolphins is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury within the CES stock during 2003-2007 is unknown. It is not possible to estimate the total number of interactions or mortalities associated with crab pots since there is no systematic observer program. However, it is clear that this interaction is a common occurrence in this area and does result in mortalities of estuarine bottlenose dolphins (Burdett and McFee 2004).

Fishery Information

The only documented reports of fishery-related mortality or serious injury to this stock are associated with the blue crab pot fishery.

Crab Pots

One of the largest commercial fisheries in South Carolina's coastal waters is the Atlantic blue crab (*Callinectes sapidus*) fishery, which operates year round with the predominant fishing occurring from August to November. Burdett and McFee (2004) reviewed bottlenose dolphin strandings in South Carolina from 1992 to 2003 and found that 24% of the 42 entanglements of dolphins were associated with crab pots with an additional 19% of known entanglements deemed as probable interactions with crab pots.

Between 2003 and 2007, 5 stranded bottlenose dolphins recovered in the CES displayed evidence of interaction with a crab pot (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). During 2003, 2 bottlenose dolphins were observed entangled in crab pot lines in the CES, including 1 that was released alive and has been resighted at least 9 times (NOAA/NOS/NCCOS unpublished data.). From 2004 to 2006, 4 bottlenose dolphins in the CES stranded entangled in crab pots. These animals were released alive from entangling gear and were not believed to be seriously injured. An additional dolphin stranded in 2007 had wound marks around the tail stock which might be attributable to interactions with crab pots.

Other Mortality

In addition to the dolphins reported caught in crab pots, 59 stranded bottlenose dolphins were recovered between 2003 and 2007 in the CES (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008; Table 1). It was not possible to determine whether or not there was evidence of human interactions for 23 of these strandings.

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

	2003	**2004**	**2005**	**2006**	**2007**	**TOTAL**
Total Stranded	15	12	10	13	14	64
Human Interaction						
--Fishery Interaction	2	2	2	3	0	9
--Other	0	1	0	0	1	2
No Human Interaction	8	5	3	5	9	30
CBD	5	4	5	5	4	23

Stranded carcasses are not routinely identified to estuarine or coastal stocks of bottlenose dolphins. In order to address whether a stranded dolphin in the CES was from this estuarine stock or the coastal morphotype stock, the photo-ID catalog of all dolphins individually identified since 1994 in the Charleston area was checked against any strandings in the CES for which the animal could be identified (Table 2). Seventeen (14%) of the 123 stranded dolphins were identifiable, 12 (71%) of which had been previously identified as resident estuarine dolphins belonging to the CES stock (NOAA/NOS/NCCOS unpublished data). Five additional dolphins (29%) were identifiable but did not match any dolphins in the Charleston catalog and were thus considered to be part of the coastal morphotype stock. Sixty-seven percent of the estuarine dolphins stranded in the estuarine areas and 80% of the coastal non-resident dolphins stranded along the coast. These limited data indicate that coastal dolphins (not considered part of this stock) stranded predominantly along the coast, whereas 2/3 of the estuarine resident dolphins in this stock stranded in the estuarine areas.

Table 2. Strandings of individually identified bottlenose dolphins observed in the Charleston Estuarine System stock. Represented are the number (and percentage) of identified dolphins relative to where the stranding occurred. Unpublished data from NOAA/NOS/NCCOS.

	# Dolphins Stranded	**# Stranded in Estuary**	**# Stranded on Coast**
Estuarine Dolphins	12	8/12 (67%)	4/12 (33%)
Coastal Dolphins	5	1/5 (20%)	4/5 (80%)
Total Dolphins	17	9/17 (53%)	8/17 (47%)

Stranding data underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fishery interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

There have been occasional mortalities of bottlenose dolphins during research activities including both directed dolphin capture-release studies and fisheries surveys. In August 2002, a dolphin became entangled in a trammel net and died during a South Carolina Department of Natural Resources' fisheries research project in the Wando River, South Carolina (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). A second dolphin was also involved in the incident and may also have died (NOAA/NOS/NCCOS unpublished data). During August 2004, 1 female bottlenose dolphin died during a health assessment capture study in Charleston.

This stock inhabits areas of high human population densities, where a large portion of the stock's range is highly industrialized or agricultural. Strandings in South Carolina were greater near urban areas and those with agricultural input, suggesting adverse health effects to estuarine dolphins in these developed areas (McFee and Burdett 2007).

Numerous studies have investigated the health status and risks for bottlenose dolphins in the CES. Reduced immune response was correlated with increasing whole blood concentrations of several contaminants in bottlenose dolphins from the Charleston area (Kannan *et al.* 1997). Significantly higher total mercury was found in adult females than juvenile females while the highest manganese levels were found in juvenile females. Total mercury concentrations were significantly correlated with age, while the inverse was true for copper, manganese, lead, uranium and zinc. (McFee *et al.* in press) found age-related variation in growth rates between bottlenose dolphin sexes and some variation (e.g., asymptotic length) between geographic cohorts, which may be the result of contaminant ingestion.

Some of the highest concentrations of polychlorinated biphenlys (PCBs) and DDT reported for cetaceans have been found in the blubber of bottlenose dolphins sampled near Charleston (Kuehl and Haebler 1995; Houde *et al.* 2006b). Blubber concentrations of organohaline pollutants found in male dolphins near Charleston exceeded toxic threshold values and may result in adverse effects on health or reproductive rates (Hansen *et al.* 2004; Schwacke *et al.* 2004).

Persistent organic pollutant (POP) accumulation in the blubber of bottlenose dolphins sampled near Charleston indicated Cytochrome P4501A1 expression in the deep blubber layer was strongest, with highest concentrations found in simultaneously pregnant-lactating females (Montie *et al.* 2008). During periods of lipid mobilization (e.g., during fasting, starvation, adaptation to warmer water temperatures, lactation or a combinations of these), stored blubber lipids may be redistributed into the circulatory system, enhancing their metabolism, which may interfere with thyroid hormone homeostasis and other essential processes (Montie *et al.* 2008; Vecchione *et al.* 2008).

Fair *et al.* (2007) found mean total polybrominated diphenyl ethers (PBDEs) concentrations, associated with sewage sludge and urban runoff, were 5 times greater in the blubber of Charleston dolphins than levels reported for dolphins in the Indian River Lagoon and represent some of the highest measured in marine mammals. Temporal trends in levels of PCBs and PBDEs were evaluated by comparing bottlenose dolphin samples from the 1990's and from the 2000's (Johnson-Restrepo *et al.* 2005). An exponential increase in concentrations of these synthetic contaminants over the 10-year period was measured, with an estimated doubling time of 3-4 years for Florida dolphins.

Unlike PCB and organochlorine contaminants, perfluoroalkyl compounds (PFCs) are detected in higher concentrations in the water column than in sediments, thereby potentially being a cause of concern for apex predators such as the bottlenose dolphin (Adams *et al.* 2008). In the Charleston area, highest PFC concentrations were detected in wastewater treatment plant effluents, fish, and dolphin plasma and tissues (Houde *et al.* 2006a). Using blood samples collected from dolphins near Charleston, Adams *et al.* (2008) found dolphins affiliated with areas characterized by high degrees of industrial and urban land use had significantly higher plasma concentrations of perfluoroctane sulfonate (PFOs), perfluorodecanoic acid (PFDA) and perfluoroundeconic acid (PFUnA) than dolphins which spent most of their time in residential areas with lower developed land use, such as wetland marshes. Dolphins residing predominantly in the Ashley, Cooper and Wando Rivers exhibited significantly greater mean plasma concentration of PFUnA than those associated with Charleston Harbor.

Bossart *et al.* (2008) found serum iron was slightly lower and serum bicarbonate was significantly higher in Charleston area dolphins with orogenital papillomas compared to healthy dolphins, while dolphins with tumors had multiple abnormalities in serum proteins and immunologic factors. Dolphins with these papillomas, which appear to be sexually transmitted, may have enhanced immunity mediated by secreted antibodies due to increased exposure to other directly transmitted pathogens.

STATUS OF STOCK

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

The status of the CES stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. The impact of crab pots on estuarine bottlenose dolphins is currently unknown, but has been shown to be considerable in the CES (Burdett and McFee 2004). Because the stock

size is currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*)
Northern Georgia/Southern South Carolina Estuarine System Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Except for animals residing within the Southern North Carolina and Northern North Carolina Estuarine Systems (e.g., Waring *et al.* 2007)), estuarine dolphins along the U.S. east coast have not previously been included in stock assessment reports. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several areas (Caldwell 2001; Gubbins 2002a; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Balmer *et al.* in press). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005).

The Northern Georgia/Southern South Carolina Estuarine System (NGSSCES) stock is bounded in the north by the southern border of the Charleston Estuarine System stock at the southern extent of the North Edisto River and extends southwestward to the northern extent of Ossabaw Sound. It includes St. Helena, Port Royal, Calibogue and Wassaw Sounds as well as the estuarine waters of the rivers and creeks that lie within this area (Figure 1). Photo-ID matches of estuarine animals from the NGSSCES region and the estuarine stocks to the north and south have not been made (Urian *et al.* 1999). The borders are based primarily on results of photo-ID studies conducted by Gubbins (2002a; b; 2002c) in this region, and photo-ID and telemetry research carried out north of this region (Zolman 2002; Speakman *et al.* 2006), and are subject to change upon further study of dolphin residency patterns in estuarine waters of South Carolina and Georgia.

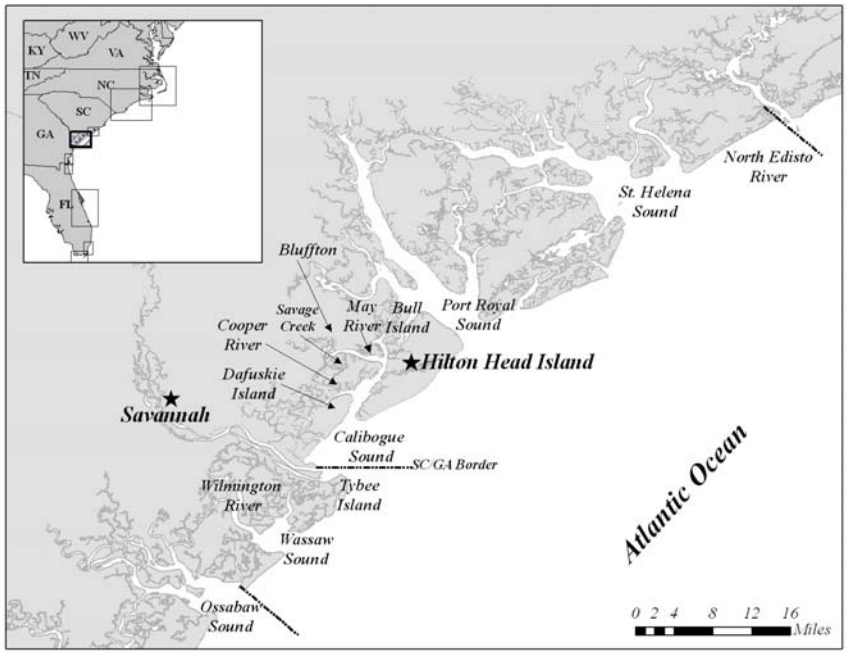

Figure 1. *Geographic extent of the Northern Georgia/Southern South Carolina Estuarine System (NGSSCES) stock. The borders are denoted by dashed lines.*

The NGSSCES stock has been defined as a separate estuarine stock primarily based upon the results of photo-ID and behavioral studies. From 1994 to 1998, Gubbins (2002a; b; 2002c) surveyed an area bordered on the north by the May River, on the south by the Calibogue Sound, on the west by Savage Creek and on the east by Hilton Head Island. Broad Creek, which bisects Hilton Head Island, and nearshore ocean waters out to 2 km at the mouth of Calibogue Sound were included and were regularly surveyed. Occasional surveys were made around the perimeter of Hilton Head Island.

Gubbins (Gubbins 2002b) categorized each dolphin identified in the Hilton Head area as a year-round resident or a seasonal transient based on overall resighting patterns. Residents were seen in all 4 seasons whereas transients

were seen only in 1 or 2 seasons. Resident dolphins were observed from 10 to 116 times, whereas transients were observed less than 9 times (Gubbins 2002b). Sixty-four percent of the dolphins photographically identified were resighted only once between 1994 and 1998. Both resident and transient dolphins occurred in waters of Calibogue Sound (Gubbins 2002b; Gubbins 2002c; Gubbins *et al.* 2003), whereas in the tidal creeks and rivers, primarily small, tight groups of resident dolphins were seen, with only an occasional transient dolphin observed in these estuarine areas. Two dolphins were resighted between Hilton Head and Jacksonville, which likely represent transients or seasonal residents (Gubbins 2002b). Gubbins *et al.* (2003) reported dolphin abundance in the Hilton Head area was lowest from February to April, with 2 peaks in abundance observed in May and July. Some dolphins were sighted for short periods of time in the summer, indicating transients or seasonal residents may move inshore to this area during the summer months.

Dolphins residing within estuaries south of this stock down to the northern boundary of the Southern Georgia Estuarine System (SGES) stock are currently not included in any Stock Assessment Report. There are insufficient data to determine whether animals south of the NGSSCES stock exhibit affiliation to the NGSSCES stock, to the SGES stock to the south or are deserving of their own stock status. Further research is needed to establish affinities of dolphins in this region. It should be noted, however, that in this intervening region during 2003-2007, 7 dead stranded dolphins were reported but it could not be determined if there was evidence of human interactions for 6 of these stranded animals and for 1 animal no evidence of human interactions was detected.

POPULATION SIZE

The total number of bottlenose dolphins residing within the NGSSCES stock is unknown. Data collected by Gubbins (2002b) were incorporated into a larger study that used mark-recapture analyses to calculate abundance in 4 estuarine areas along the eastern U.S. coast (Gubbins *et al.* 2003). Sighting records collected only from May through October were used, as this limited time period was determined to reduce the possibility of violating the mark-recapture model's assumption of geographic closure and mark retention. Based on photo-ID data from 1994 to 1998, 234 individually identified dolphins were observed (Gubbins *et al.* 2003), which included 52 year-round residents and an unspecified number of seasonal residents and transients. Mark-recapture analyses included all the 234 individually identifiable dolphins and the population size for the Hilton Head area was calculated to be 525 dolphins (CV=0.16; Gubbins *et al.* 2003). This is an overestimate of the stock abundance within the study area covered by Gubbins *et al.* (2003) because it includes non-resident and seasonally resident dolphins. In addition, the study area did not encompass the entire area occupied by the NGSSCES stock and therefore cannot be considered a reliable estimate of abundance for this stock.

Minimum Population Estimate

The minimum population estimate for this stock of bottlenose dolphins is unknown.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the NGSSCES stock is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the NGSSCES stock of bottlenose dolphins is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury within the NGSSCES stock during 2003-2007 is unknown. It is not possible to estimate the total number of interactions or mortalities associated with crab pots since there is no systematic observer program. However, it is clear that this interaction occurs elsewhere within estuarine

habitats of the southeastern U.S. coast and does result in mortalities of estuarine bottlenose dolphins (Burdett and McFee 2004).

Fishery Information

The only documented reports of fishery-related mortality or serious injury to this stock are associated with the blue crab pot fishery.

Crab Pots

Between 2003 and 2007, 4 stranded bottlenose dolphins displayed evidence of interaction with a crab pot in the NGSSCES (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). One entanglement occurred in August 2005 in the northern reaches of the Wilmington River and 3 crab pot entanglements occurred in 2006 (1 in March in Wassaw Sound, 1 live dolphin was reported in May on Hilton Head Island and 1 entanglement occurred in June on Daufuskie Island).

Other Mortality

From 2003 to 2007, 51 additional bottlenose dolphins were reported stranded within the NGSSCES area (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). It could not be determined if there was evidence of human interactions for 34 of these strandings, and no evidence of human interaction was detected for 15. One stranded dolphin showed evidence of human interaction, but not fishery interaction (propeller wounds), and an additional dolphin stranded in March 2006 in Tybee Creek at Morgan Cut with signs of net entanglement noted on the dorsal fin but the type of fishery was not identified. Stranding data underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fishery interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

There have been occasional mortalities of bottlenose dolphins during research activities including both directed live-capture studies and fisheries surveys. Three dolphins were killed in Georgia Department of Natural Resources' research trammel nets, including a mother/calf pair in March 2004 in Tybee Creek, Georgia, and 1 dolphin in House Creek (Little Tybee Island) in November 2004.

This stock inhabits areas with significant drainage from urban and agricultural areas and as such is exposed to contaminants in runoff from those sources. There is no estimate of indirect human-caused mortality from pollution or habitat degradation for this stock. However, high tissue concentrations of anthropogenic contaminants are likely to have an effect on reproduction and population health (Hansen *et al.* 2004; Schwacke *et al.* 2004; Reif *et al.* 2008).

Blubber samples were collected from 7 bottlenose dolphins in the Turtle/Brunswick River Estuary (TBRE) and dolphins stranded in Wassaw, Ossabaw and St. Catherine's Sounds (Pulser and Maruya 2008). Total PCB concentrations were 10 times higher in dolphins from the TBRE compared to the stranded animals from the Savannah area. The signature of Aroclor 1268, a PCB used in roofing and caulking compounds, was distinct between the TBRE and Savannah area dolphins and closely resembled those of local prey fish species (Pulser and Maruya 2008).

Gubbins (2002c) speculated that the most serious threat to Hilton Head dolphins is handouts of food, as provisioned dolphins spend more time alone and in smaller groups leaving them vulnerable to shark attacks, more aggressive with each other in an attempt to get free food, and less wary of humans, leaving them open to injury or death from boat propellers, spoiled fish or even shooting. There are emerging questions regarding potential linkages between provisioning wild dolphins, dolphin depredation of recreational fishing gear, and associated entanglement and ingestion of gear. High boat activity in the Hilton Head area could result in a change in movement patterns, alteration of behavior of both dolphins and their prey, disruption of echolocation and masking of communication, physical damage to ears, collisions with vessels and degradation of habitat quality (Richardson *et al.* 1995; Ketten 1998; Gubbins 2002b; Gubbins *et al.* 2003; Mattson *et al.* 2005). The effect of boat activity was investigated by Mattson *et al.* (2005) during the summer of 1998 along Hilton Head Island. Dolphins changed behavior more often when boats were present, and group size was significantly larger in the presence of 1 boat and was largest when multiple boats were present. Jet skis elicited a strong and immediate reaction with dolphins remaining below the surface for long periods of time. Dolphins always changed behavior and direction of movement in the presence of shrimp boats, while ships and ferries elicited little to no obvious response. One documented impact from boats was recorded in September 2006 when a dolphin stranded at Bluffton with propeller wounds on its back (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008).

STATUS OF STOCK

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

The status of the NGSSCES stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. The total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. The impact of crab pots on estuarine bottlenose dolphins is currently unknown, but has been shown to be considerable in the Charleston Estuarine System stock (Burdett and McFee 2004). Because the stock size is currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

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STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Except for animals residing within the Southern North Carolina and Northern North Carolina Estuarine Systems (e.g., Waring *et al.* 2008), estuarine dolphins along the U.S. east coast have not previously been included in stock assessment reports. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Balmer *et al.*, in press). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the Atlantic coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005).

The Southern Georgia Estuarine System stock (SGES) is bounded in the south by the Georgia/Florida border at the Cumberland River and in the north by the Altamaha River inclusive and encompasses all estuarine waters in between, including but not limited to the Intracoastal Waterway, St. Andrew and Jekyll Sounds and their tributaries, St. Simon Sound and tributaries, and the Turtle/Brunswick River Estuary (TBRE) system (Figure 1). The southern boundary abuts the northern boundary of the Jacksonville stock, previously defined based on a photo-ID project (Caldwell 2001). The northern border is defined based on continuity of estuarine habitat, and a significantly high and unique contaminant burden found in dolphins from this area (Pulster and Maruya 2008). These boundaries are subject to change upon further study of dolphin residency patterns in estuarine waters of central and northern Georgia.

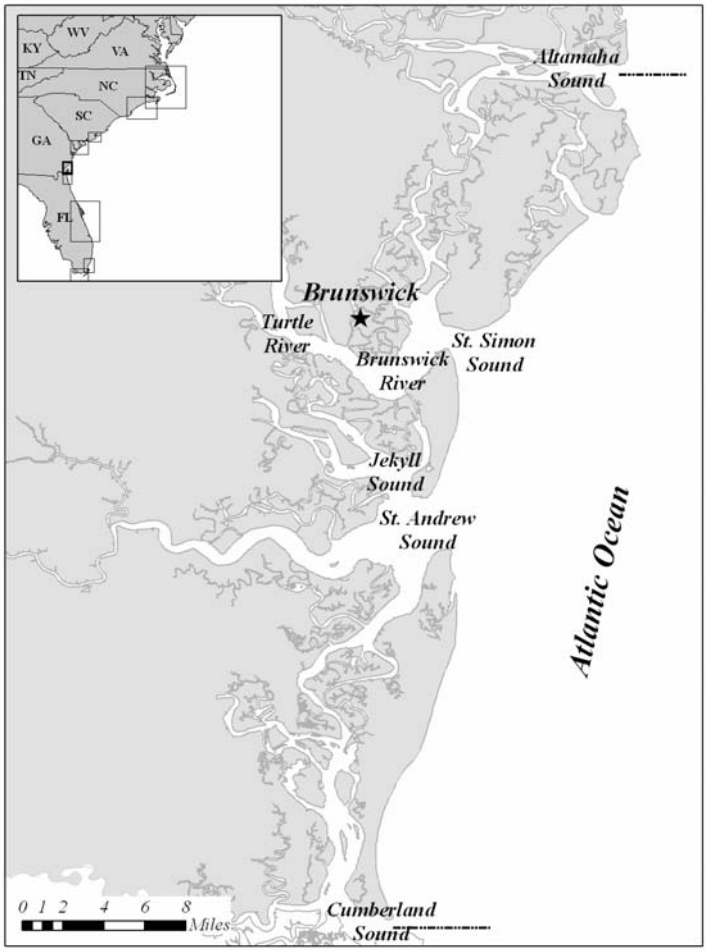

Figure 1. *Geographic extent of the Southern Georgia Estuarine System (SGES) stock. The borders are denoted by dashed lines.*

Genetic analysis of mitochondrial DNA control region sequences and microsatellite markers of dolphins biopsied in the SGES showed significant differentiation from animals biopsied in northern Georgia and southern South Carolina estuaries as well as from animals biopsied in coastal waters >1 km from shore at the same latitude (NMFS unpublished data). In addition, bottlenose dolphins in the TBRE exhibit contaminant burdens consistent with long-term fidelity to the TBRE (Pulster and Maruya 2008).

Dolphins residing in the estuaries north of this stock between Altamaha Sound, Georgia, and Wassaw Sound, Georgia, are not currently covered in any stock assessment report. There are insufficient data to determine whether animals in this region exhibit affiliation to the SGES stock or to the stock to the north, the Northern

Georgia/Southern South Carolina Estuarine System stock or should be delineated as their own stock. Further research is needed to establish affinities of dolphins in this region. It should be noted, however, that in this intervening region during 2003-2007, 7 dead stranded dolphins were reported but it could not be determined if there was evidence of human interactions for 6 of these stranded animals and for 1 animal no evidence of human interactions was detected.

POPULATION SIZE

The total number of bottlenose dolphins residing within the Southern Georgia Estuarine System stock is unknown. The Georgia Dolphin Project conducted quarterly boat-based surveys from 1992 to 2003 to photograph and count dolphins, but no abundance estimate has been published from this work. Gubbins *et al.* (2003), using photo-ID methods to identify individual dolphins, provided an estimate of 525 dolphins (CI: 399, 728) for a portion of the area covered by the SGES stock. However, these data were collected during May - October 1997 and hence are considered expired. In 2008, new efforts to estimate abundance in a portion of the SGES from St. Simons Sound to the Altamaha River were initiated (Balmer, pers. comm.). Mark-recapture, photo-ID surveys are planned for every season for 2 years and were started in February 2008 (Balmer, pers. comm.). This research should yield an abundance estimate for a large portion of this stock's range.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate for the Southern Georgia Estuarine System stock of bottlenose dolphins.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the SGES stock of bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for this stock of bottlenose dolphins is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury of the SGES bottlenose dolphin stock during 2003-2007 is unknown.

Fishery Information

Crab Pots

Between 2003 and 2007, there were 2 documented reports of fishery-related interactions for this stock: 1 attributed to commercial blue crab pot gear; the second involved gear consistent with the crab pot fishery (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). One of the 2 animals was disentangled and released alive (condition unknown) and the second was seen towing ~2-3m of white line with a buoy on the end. Disentanglement efforts failed. In addition, there was a documented crab pot entanglement in 2001 in which the animal was released alive. 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, bottlenose dolphin interactions with and entanglement in crab pot gear are well documented and mortalities have occurred in estuarine areas similar to the estuarine waters of southern Georgia (Burdett and McFee 2004). Thus, the potential for crab pot fishery gear to cause mortalities of bottlenose dolphins in the SGES should not be discounted.

Other Mortality

From 2003 to 2007, 15 additional bottlenose dolphins were reported stranded within the SGES (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). It was not possible to make any determination of possible human interaction for 14 of these strandings. For the remaining dolphin, no evidence of human interactions was detected. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fishery interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

A portion of the stock's range is highly industrialized, and the Environmental Protection Agency has included 4 sites within the Brunswick area on its National Priority List (NPL) of hazardous waste sites (EPA 2008). Specifically, the LCP Chemicals Site contaminated soils, groundwater and adjacent marsh with mercury and polychlorinated biphenyls (PCBs). Mean total polychlorinated biphenyl (PCB) concentrations from dolphins biopsied in the Turtle/Brunswick River Estuary (Pulster and Maruya 2008; Sanger *et al.* 2008) were significantly higher than dolphins sampled in other areas of the world including other inshore estuarine waters along the Southeast coast of the United States (Schwacke *et al.* 2002; Hansen *et al.* 2004; Litz 2007). PCB congeners measured in tissues of dolphins biopsied in the TBRE system were enriched in highly chlorinated homologs consistent with Aroclor 1268 (Pulster and Maruya 2008; Sanger *et al.* 2008). The TBRE area is known to be contaminated with this specific PCB mixture in soil and sediments, and the transport of these contaminants into the food web through invertebrate and vertebrate fauna has been documented (Kannan *et al.* 1997; Kannan *et al.* 1998; Maruya and Lee 1998).

Studies have suggested an increased risk of detrimental effects on reproduction and endocrine and immune system function for marine mammals in relation to tissue concentrations of PCBs (De Swart *et al.* 1996; Kannan *et al.* 2000; Schwacke *et al.* 2002). Thus, the high levels of PCBs recorded in dolphins from this stock raise concern for the long-term health and viability of the stock. However, there are no estimates of indirect human-caused mortality from pollution or habitat degradation. Studies of the distribution and health of bottlenose dolphins in this area are ongoing (Sanger *et al.* 2008; Schwacke, pers. comm.).

STATUS OF STOCK

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

The status of the SGES stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. The total human-caused mortality and serious injury for this stock is unknown and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Entanglements in both commercial and recreational crab pot fisheries are documented, and detrimental impacts of high pollutant burdens may be a significant issue for this stock due to the high mean total polychlorinated biphenyl (PCB) concentrations found in the blubber of animals in this region. Because the stock size is currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*)
Jacksonville Estuarine System Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Except for animals residing within the Southern North Carolina and Northern North Carolina Estuarine Systems (e.g., Waring *et al.* 2009), estuarine dolphins along the U.S. east coast have not previously been included in stock assessment reports. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several areas (Caldwell 2001; Gubbins 2002; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Balmer *et al.* in press). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005).

The Jacksonville Estuarine System (JES) stock is bounded in the north by the Florida/Georgia border at Cumberland Sound, abutting the southern border of the Southern Georgia Estuarine System stock, and extends south to Jacksonville Beach, Florida. This encompasses an area defined during a photo-ID field study of bottlenose dolphin residency patterns in the area (Caldwell 2001). The habitat is comprised of several large brackish rivers, including St. Mary's, Amelia, Nassau, Fort George and St. John's Rivers (Figure 1). The St. John's River is a deep, swift moving river with heavy boat and shipping activity (Caldwell 2001). The remainder of the area is made up of tidal marshes and riverine systems averaging 2m in depth over sand, mud or oyster beds, and is bisected by the Intracoastal Waterway. The borders are subject to change upon further study of dolphin residency patterns in estuarine waters of southern Georgia and Florida.

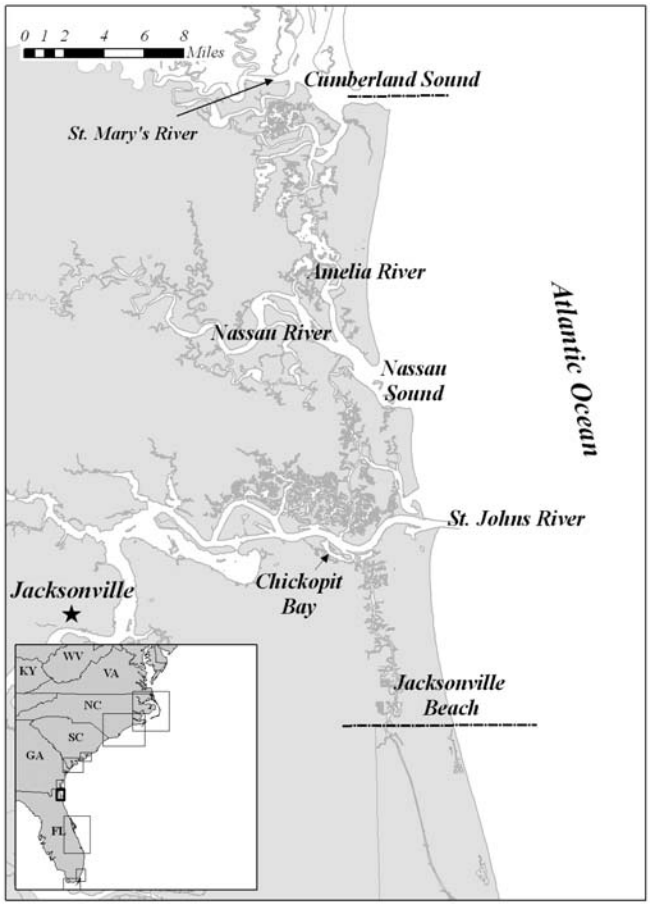

Figure 1. *Geographic extent of the Jacksonville Estuarine System (JES) stock. The borders are denoted by dashed lines.*

The JES stock has been defined as a separate estuarine stock primarily by the results of photo-ID and genetic studies. Caldwell (2001) investigated the social structure of bottlenose dolphins inhabiting the estuarine waters between the St. Mary's River and Jacksonville Beach, Florida, using photo-ID and behavioral data obtained from December 1994 through December 1997. Three behaviorally different communities were identified during this study, namely the estuarine waters north of St. John's River (termed the Northern area), the estuarine waters south of St. John's River (the Southern area) and the coastal area, all of which differed in density, habitat fidelity and social affiliation patterns. Caldwell (2001) found that dolphins inhabiting the Northern area were the most isolated, with 96% of the groups observed containing dolphins that had been photographically identified only in this area, demonstrating strong year-round site fidelity.

Cluster analyses suggested that dolphins using the Northern area did not socialize with those using the Southern area. In the Southern area, 78% of the groups were photographed only in this region (Caldwell 2001). However, these dolphins migrated into and out of the Jacksonville area each year, returning to the area during 3 consecutive summers, suggesting the Southern area dolphins may show summer site fidelity as opposed to the year-round fidelity demonstrated in the Northern area. Caldwell (2001) found that dolphins found in the coastal areas were highly mobile, had fluid social affiliations, were not sighted more than 8 times over the entire study and showed no long-term (>4 months) site fidelity. Three of these dolphins were also sighted off South Carolina, behind shrimp boats. These coastal dolphins are thus considered to be members of the coastal morphotype stocks.

The JES stock demonstrated oscillating abundance year round (Gubbins *et al.* 2003) with low numbers reported in January and December. There was a positive correlation between dolphin abundance and water temperature, with peak numbers seen when water temperatures rose above 16°C.

Caldwell (2001) examined genetic differentiation among the Northern, Southern and coastal areas of the study site using mitochondrial DNA sequences and microsatellite data. Both mitochondrial DNA haplotype and microsatellite allele frequencies differed significantly between the Northern and Southern sampling areas. Differentiation between the Southern sampling area and the coast was lower, but still significant. These genetic data are in line with the behavioral analyses. However, sample sizes were small for these estuarine regions ($n \leq 25$) and genetic analyses did not account for the high number of closely related individuals within the dataset. Further analyses are necessary to confirm the results.

Despite the strong fidelity to the Northern and Southern areas, dolphins were photographed outside their preferred areas, supporting the proposal to include both these areas within the boundaries of the JES stock. Future analyses may provide additional information on the importance of the Southern area to the resident stock, and thus the inclusion of both areas in this stock boundary may be modified with additional data or further analyses.

Dolphins residing within estuaries south of this stock down to the northern boundary of the Indian River Lagoon Estuarine System stock are currently not included in any Stock Assessment Report. There are insufficient data to determine whether animals south of the JES stock exhibit affiliation to the JES stock, the IRLES stock to the south or are simply transient animals associated with coastal stocks. Further research is needed to establish affinities of dolphins in this region. It should be noted that during 2003-2007, there were 16 stranded bottlenose dolphins in this region in estuarine waters. Evidence of human interactions was detected for 4 of these stranded dolphins, 2 of which involved fishery interactions, including a crab pot entanglement. The other 2 interactions involved boat collisions (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008).

POPULATION SIZE

The total number of bottlenose dolphins residing within the JES stock is unknown. Data collected by Caldwell (2001) were incorporated into a larger study that used mark-recapture analyses to calculate abundance in 4 estuarine areas along the eastern U.S. coast (Gubbins *et al.* 2003). Sighting records collected only from May through October were used, as this limited time period was determined to reduce the possibility of violating the mark-recapture model's assumption of geographic closure and mark retention. Based on photo-ID data from 1994 to 1997, 334 individually identified dolphins were observed (Gubbins *et al.* 2003), which included an unspecified number of seasonal residents and transients. Mark-recapture analyses included all the 334 individually identifiable dolphins, and the population size for the JES stock was calculated to be 412 residents (CV=0.06; Gubbins *et al.* 2003). This is an overestimate of the stock abundance in the area covered by the study because it includes non-resident and seasonally resident dolphins. Caldwell (2001) indicated that 122 dolphins were resighted at least 10 times in the JES, with 33 individuals observed primarily in the Northern area, and 89 individuals reported to use the Southern area..

Minimum Population Estimate

The minimum population estimate for this stock of bottlenose dolphins is unknown.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the JES stock is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR is unknown for this stock.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury within the JES stock during 2003-2007 is unknown. It is not possible to estimate the total number of interactions or mortalities associated with crab pots since there is no systematic observer program. However, this interaction is a common occurrence elsewhere within estuarine habitats of the southeastern U.S. coast and does result in mortalities of estuarine bottlenose dolphins (Burdett and McFee 2004).

Fishery Information

Crab Pots

Between 2003 and 2007, 1 bottlenose dolphin carcass recovered within the JES area displayed evidence of possible interaction with a trap/pot fishery (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008).

Other Mortality

From 2003 to 2007, 16 additional stranded bottlenose dolphins were recovered within the JES area (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). For 3 dolphins, no evidence of human interactions was detected. It was not possible to make a determination of human interaction for the remaining 12 strandings. Stranding data underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fishery interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

This stock inhabits areas with significant drainage from industrial and urban sources, and as such is exposed to contaminants in runoff from these. No contaminant analyses have yet been conducted in this area, so there is no estimate of indirect human-caused mortality from pollution or habitat degradation for this stock. In other estuarine areas where such analyses have been conducted, exposure to anthropogenic contaminants have been found to likely have an effect (Hansen *et al.* 2004; Schwacke *et al.* 2004; Reif *et al.* 2008).

STATUS OF STOCK

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

The status of the JES stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. The impact of crab pots on estuarine bottlenose dolphins is currently unknown, but has been shown to be considerable in the Charleston Estuarine System stock (Burdett and McFee 2004). Because the stock size is currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*)
Indian River Lagoon Estuarine System Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of bays, sounds and estuaries. Except for animals residing within the Southern North Carolina and Northern North Carolina Estuarine Systems (e.g., Waring *et al.* 2007), estuarine dolphins along the U.S. east coast have not previously been included in stock assessment reports. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several areas of the southeastern United States (e.g., Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (e.g., Wells *et al.* 1987; Balmer *et al.* in press). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between biopsies collected from bottlenose dolphins along the coast and those collected within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been reported for the west coast of Florida (Sellas *et al.* 2005).

The Indian River Lagoon Estuarine System (IRLES) stock on the Atlantic coast of Florida extends from Ponce de Leon Inlet in the north to Jupiter Inlet in the south and encompasses all estuarine waters in between, including but not limited to the Intracoastal Waterway, Mosquito Lagoon, Indian River, Banana River and the St. Lucie Estuary. Five inlets and the Cape Canaveral Locks connect the IRLES to the Atlantic Ocean. This definition of the IRLES has been used by a number of researchers (e.g., Kent *et al.* 2008) and is the most expansive definition. Some researchers truncate the southern border at the St. Lucie Inlet.

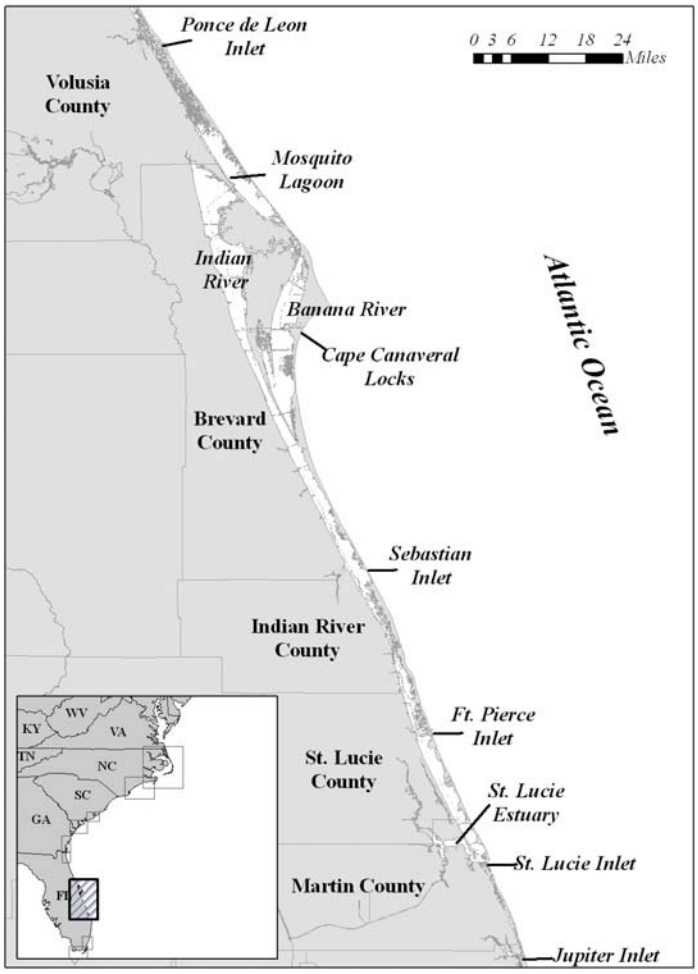

Figure 1. *Geographic extent of the Indian River Lagoon Estuarine System (IRLES) stock.*

Multiple studies utilizing varying methods such as freeze-branding, photo-ID and radio telemetry support the designation of bottlenose dolphins in the IRLES as a distinct stock. Odell and Asper (1990) reported that none of the 133 freeze-branded dolphins from the IRLES were observed outside of the system during their 4-year monitoring period from 1979 to 1982 and suggested that there may be an additional discrete group of dolphins in the southern end of the system. A stranded dolphin from the IRLES that was rehabilitated, freeze-branded and released into the IRLES was recaptured 14 years later in the IRLES during a health assessment project (Mazzoil *et al.* 2008b). Photo-ID studies have provided evidence that some dolphins in the IRLES exhibit both short-term and long-term site fidelity (Mazzoil *et al.* 2005; Mazzoil *et al.* 2008a). During a 5-year study (1996-2001) in the IRLES, 67 individual dolphins were sighted 8 or more times, which included 11 dolphins freeze-branded from the Odell and Asper (1990) study

that were sighted at least once (Mazzoil *et al.* 2005). In addition, Mazzoil *et al.* (2008a) suggested that at least 3 different dolphin communities exist within the IRLES based on analyses of photo-ID data. Radio-tracking of 2 rehabilitated dolphins stranded in the IRLES indicated that neither dolphin left the IRLES from the time of release until their deaths in 100 days and 7days, respectively (Mazzoil *et al.* 2008b).

Dolphins residing within estuaries north and south of this stock are currently not included in any Stock Assessment Report. There are insufficient data to determine whether animals south of the IRLES exhibit affiliation to the Biscayne Bay stock or are simply transient animals associated with coastal stocks. Similarly, there are insufficient data to determine whether animals in estuarine waters north of the IRLES exhibit affiliation to the IRLES stock or to the Jacksonville Estuarine System stock to the north or are simply transients. There is relatively limited estuarine habitat along the coastline south of the IRLES but some potentially suitable habitat north of the IRLES. Further research is needed to establish affinities of dolphins in these regions. It should be noted that during 2003-2007, there were 16 stranded bottlenose dolphins in the region north of the IRLES in enclosed waters. Evidence of human interaction was detected for 4 of these strandings, including 2 fishery interactions with crab pots (1 of these was a live animal that was disentangled) and 2 boat strikes (1 fresh prop marks and 1 healed prop marks). There were 3 estuarine strandings south of the IRLES. One of these had signs human of interaction from a boat strike and another was identified as belonging to the offshore morphotype.

POPULATION SIZE

Population size estimates for this stock are greater than 8 years old and therefore the current population size for the stock is considered unknown (Wade and Angliss 1997). Abundance estimates ranging from 206 to 816 dolphins (Table 1) were made in the 1970's and 1980's in response to bottlenose dolphin live-capture fisheries where 68 dolphins were permanently removed between 1973 and 1988 for captive display in marine parks (Scott 1990). No dolphins have been removed from the IRLES since 1989. Abundances based on aerial and small boat-based strip- or line-transect surveys were estimated to establish capture quotas or to assess the impact of the removals (Scott 1990). Scott (1990) suggested that a large number of bottlenose dolphins moved into the IRLES during the summer from the adjacent Atlantic Ocean. However, preliminary analyses of extensive photo-ID data collected throughout the IRLES and the adjacent Atlantic from 2002 to 2008 do not support this hypothesis and indicate very few bottlenose dolphins move between the IRLES and the Atlantic Ocean (Mazzoil, pers. comm.). During photo-ID studies conducted in the IRLES for 3 years from 2002 to 2005, 615 bottlenose dolphins with distinct dorsal fins were identified (Mazzoil *et al.* 2008a). While mortality of some of these 615 identified dolphins certainly occurred during the 3 years, there were also dolphins with indistinct dorsal fins that were not included in the count. This number of dolphins is also comparable to the larger abundances previously estimated (506-816 dolphins) which were based on small boat surveys (Mullin *et al.* 1990) and a mark-recapture study (Burn *et al.* 1987) and were probably less negatively biased compared to the aerial surveys. Analyses of recently collected aerial survey data and capture-recapture analyses from the photo-ID studies are currently underway that should yield updated abundance estimates (Noke-Durden, pers. comm.; Mazzoil, pers. comm.).

Table 1. Abundance estimates for the Indian River Lagoon System.

Study	Type	Year & Month	N_{best}	CV
Leatherwood (1979)	Aerial - transect	1977 August	438	0.15
Thompson (1981)	Aerial - transect	1980 May	206	0.42
	Aerial - transect	1980 August	435	0.19
	Aerial - transect	1980 November	202	0.26
Leatherwood (1982)	Aerial - transect	1979 November	222	0.08
	Aerial - transect	1980 January	214	0.10
Burn *et al.* (1987)	Mark - recapture	1982	553	~ 0.05
Mullin *et al.* (1990)	Boat - transect	1985 July	816	0.15
	Boat - transect	1986 March	506	0.21
Griffin and Patton (1990)	Aerial - transect	1987-1990	143[a]	0.09

[a] Average of seasonal surveys

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate for the IRLES stock of bottlenose dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this stock. It would be difficult to use historical abundance estimates for meaningful trend analysis due to differences in the survey and analytical methods, and specific areas surveyed.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the IRLES stock of bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the IRLES stock of bottlenose dolphins is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

A bottlenose dolphin live-capture fishery operating between 1973 and 1988 in the IRLES permanently removed 68 bottlenose dolphins for captive display in marine parks (Scott 1990). No dolphins have been removed from the IRLES since 1989.

Fishery Information

Crab Pots

Interactions between bottlenose dolphins and the blue crab fishery in the IRLES have been documented. Noke and Odell (2002) observed behaviors that included dolphins closely approaching crab boats, begging, feeding on discarded bait and crab pot tipping to remove bait from the pot. Of the dolphins sighted during this 1-year study, 16.6% interacted with crab boats and these interactions peaked during summer months. Also during the 1-year study, in March 1998 a dolphin was found dead, entangled in float lines with 3 crab pots attached (Noke and Odell 2002).

Table 2. Bottlenose dolphin strandings by county within the Indian River Lagoon System from 2003 to 2007, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (accessed 10 November 2008). Please note human interaction does not necessarily mean the interaction caused the animal's death.

COUNTY		2003	2004	2005	2006	2007	TOTAL
Volusia							
	Total Stranded	**3**	**0**	**6**	**2**	**5[a]**	**16**
	Human Interaction						
	---Fishery Interaction	1	0	1	0	0	2
	---Other	0	0	0	2	1	3
	No Human Interaction	1	0	1	0	3	5
	CBD	1	0	4	0	1	6
Brevard							
	Total Stranded	**23**	**29**	**21**	**32**	**41**	**146**
	Human Interaction						
	---Fishery Interaction	3	6	3	8	5	25
	---Other	0	1	0	2	2	5
	No Human Interaction	5	6	2	4	4	21
	CBD	15	16	16	18	30	95

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Indian River							
	Total Stranded	**5**	**2**	**3**	**0**	**3**	**13**
	Human Interaction						
	---Fishery Interaction	1	0	0	0	1	2
	---Other	0	1	1	0	0	2
	No Human Interaction	2	1	1	0	0	4
	CBD	2	0	1	0	2	5
St. Lucie							
	Total Stranded	**2**	**1**	**1**	**1**	**2**	**7**
	Human Interaction						
	---Fishery Interaction	0	0	0	0	1	1
	---Other	0	0	0	1	0	1
	No Human Interaction	1	1	0	0	1	3
	CBD	1	0	1	0	0	2
Martin							
	Total Stranded	**3**	**0**	**4**	**3**	**0**	**10**
	Human Interaction						
	---Fishery Interaction	2	0	0	0	0	2
	---Other	0	0	0	0	0	0
	No Human Interaction	0	0	0	2	0	2
	CBD	1	0	4	1	0	6
TOTAL							
	Total Stranded	**36**	**32**	**35**	**38**	**51**	**192**
	Human Interaction						
	---Fishery Interaction	7	6	4	8	7	32
	---Other	0	2	1	5	3	11
	No Human Interaction	9	8	4	6	8	35
	CBD	20	16	26	19	33	114

[a] Includes a mass stranding of 2 animals in December 2007

Between 2003 and 2007, 5 bottlenose dolphins recovered by the Stranding Network within the IRLES displayed evidence of interaction with a trap/pot fishery (i.e., rope and/or pots attached) (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). Four of the dolphins had been entangled in pots (0.8 dolphins per year on average). Two of the 4 entangled dolphins were recovered dead (one of which also had multiple sections of blubber removed, possibly post-mortem), 1 was released from the pot alive and 1 dolphin was recovered alive, disentangled from a pot, and was placed into rehabilitation. This dolphin, a calf, eventually lost her fluke due to severe tissue damage from the pot line and is in permanent care at Clearwater Marine Aquarium in Clearwater, Florida. The fifth dolphin had no signs of entanglement but an escape ring from a crab pot was found in its stomach upon necropsy. An additional 2 dolphins were reported by the public as entangled in pots or rope with buoys attached (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). In both of these cases, the dolphins were sighted alive and then could not be relocated. It is unclear whether these animals freed themselves or died and sank. 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, interaction with the crab fishery does occur and results in mortalities of bottlenose dolphins in the IRLES.

Other Mortality

A total of 192 bottlenose dolphins were found stranded within the IRLES from 2003 through 2007 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). Evidence of human interactions (HI; e.g., gear and debris entanglement or ingestion, mutilation, boat collision) was detected for 43 strandings, including the 7 crab pot interactions discussed above. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008). Twenty-five animals showed evidence of interaction with fishing gear, including entanglement in or ingestion of monofilament line, hooks or lures. These interactions

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may or may not have been the cause of the animal's death, and in some cases the relationship between the gear and cause of death could not be determined. Four of the 25 animals stranded alive. Two of these died shortly after stranding, 1 animal could not be relocated after the initial report, and 1 was disentangled from monofilament line and released. Two animals were entangled in monofilament line and had also ingested marine debris, which was found during the necropsy.

Feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly in areas of the Indian River Lagoon. Feeding wild dolphins is defined under the MMPA's implementing regulations as a form of "take" because it can alter the dolphins' natural behavior and increase their risk of injury or death. There are emerging questions regarding potential linkages between provisioning wild dolphins, dolphin depredation of recreational fishing gear, and associated entanglement and ingestions of gear, which is increasing through much of Florida.

The remaining 10 cases of HI were not related to interactions with fishing gear. Of these, 6 animals had evidence of boat strike, some of which were old healed wounds, others were recent. One animal was found alive entangled in marine debris and was disentangled and released. Upon necropsy, 2 other animals were found to have ingested marine debris (bringing ingestion of marine debris to a total of 5 animals overall). One animal was found with a 13cm square of blubber cut from the peduncle, possibly postmortem (bringing the total cases of carcass mutilation to 2 including the crab pot animal with blubber removed, discussed above). Another case of HI involved a person who tried to tow a live stranded dolphin back out to sea before reporting it and may have inadvertently injured it in the process. As with HI involving fishing gear, HI in the other cases may or may not have been the cause for stranding or death of the animal.

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some of the stranded dolphins may have been from a nearby coastal stock, although the proportion of stranded dolphins belonging to another stock cannot be determined because it is often unclear from where the stranded carcasses originated. However, preliminary analyses of photo-ID data suggest that many of the stranded dolphins with distinct dorsal fins found in the IRLES had been photographed within the estuary previously, and furthermore, many of them were found within their known photo-ID home ranges (Mazzoil, Stolen and Noke, in preparation). Stranding data probably underestimate the extent of mortality and serious injury resulting from HI because not all of the dolphins that die or are seriously injured in HI wash ashore, nor will all of those that do wash ashore necessarily show signs of HI. Finally, ability to recognize HI varies widely due to many factors including the condition of the carcass (for instance, later stages of decomposition and carcass scavenging).

Bottlenose dolphin stranding data from 1977 to 2005 were analyzed by Stolen *et al.* (2007) to examine spatio-temporal aspects of strandings, age/sex specific mortality patterns and human-related mortality in the IRLES. Stolen *et al.* (2007) reported that 834 total dolphins stranded during the time frame of the study, which ranged from a low of 11 animals in 1985 to a high of 61 animals in 2001. Significant findings were: more strandings occurred in spring and summer; more of the strandings were males; and juveniles stranded more frequently, followed by adults, then calves (Stolen *et al.* 2007). Human interaction (HI) (e.g., gear and debris entanglement or ingestion, mutilation, boat collision) was reported in 10.2% (n=85) of strandings. Significantly more males showed evidence of HI than females. Most strandings with HI evidence were reported in spring and summer and found in Brevard County (n=64). Ingestion of or entanglement in recreational fishing gear accounted for 54.1% (n=46), and commercial fishing interaction accounted for 23.5% (n=20) of strandings where HI was recorded (Stolen *et al.* 2007).

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to provide guidance for responses to such events. In 2001, there was a record high number of strandings in the IRLES (n=61) (Stolen *et al.* 2007). A UME was declared when 34 of these dolphins stranded in a relatively short time period (7 May – 25 August 2001) and were confined to a relatively small geographic area in central Brevard County (Stolen *et al.* 2007). The cause of this UME was undetermined; however, saxitoxin, a biotoxin produced by the algae *Pyrodinium bahamense*, was suspected to be a factor. The IRLES experienced another UME in May 2008 that continued through the summer. Forty-eight bottlenose dolphin strandings were reported as of September 2008, most of which were in the northern portion of the IRLES (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). The cause for the 2008 UME is unknown at this time and the investigation is continuing.

The IRLES is a shallow water estuary with little tidal influx which limits water exchange with the Atlantic Ocean. This allows for accumulation of land-based effluents and contaminants in the estuary, as well as fresh-water dilution from run-off and rivers. A large portion of Florida's agriculture also drains into the IRLES, including all of the sugarcane, approximately 38% of citrus and 42% of other vegetable crops (Miles and Pleuffer 1997). Dolphins in the IRLES were found to have concentrations of contaminants at levels of possible toxicological concern. Hansen

et al. (2004) speculated that polychlorinated biphenyl (PCBs) concentrations in blubber samples collected from remote biopsy of IRLES dolphins were sufficiently high to warrant additional sampling. Durden *et al.* (2007) found mean mercury concentrations in IRLES dolphins were positively correlated with age and length and tended to be slightly higher than dolphins from the Gulf of Mexico and South Carolina coasts. In the same study, 5 animals were found to have mercury concentrations exceeding 100ppm, which may be associated with toxic effects in marine mammals (Durden *et al.* 2007). Blubber samples from surgical biopsies taken from bottlenose dolphins in the IRLES were analyzed by Fair *et al.* (2007) for polybrominated diphenyl ethers (PBDEs), establishing baseline levels for this current use compound. There are no reports of mortalities in the IRLES resulting solely from contaminant concentrations.

Bottlenose dolphins captured in the IRLES during the Health and Risk Assessment (HERA) project had lobomycosis, a chronic mycotic disease of the skin caused by *Lacazia loboi* (Reif *et al.* 2006) and orogenital papillomatosis (Bossart *et al.* 2005). Results indicated that of the 89 dolphins captured in the IRLES, 9 (10.1%) had lobomycosis and 10 (11.2%) had orogenital papillomatosis (Reif *et al.* 2008). All 9 dolphins with lobomycosis were from the southern portion of the IRLES (Reif *et al.* 2006). Afflicted dolphins showed no significant difference in prevalence of the disease between sexes and were significantly older than non-afflicted dolphins (Reif *et al.* 2006). Basis for presence and localization of lobomycosis to the southern portion of the IRLES is currently unknown, but may be related to immunosupression and environmental factors such as freshwater influx and exposure to contaminants (Reif *et al.* 2006). There are no reports of mortalities resulting solely from infection of either disease.

STATUS OF STOCK

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

The status of the IRLES stock relative to OSP is unknown. This species is not listed as threatened or endangered under the Endangered Species Act and there are insufficient data to determine population trends for this stock. The removal of dolphins in live-capture fisheries in the 1970's and 1980's and the occurrence of 2 UMEs of bottlenose dolphins in the IRLES since 2001 (NMFS unpublished data) is cause for concern; however, the effects of the permanent removals and the mortality events on stock abundance have not yet been determined. The limited ranging behavior of potentially 3 or more discrete dolphin communities and the geographic localization of previous UMEs suggest that mortality impacts may be more significant when analyzed on a smaller spatial scale.

Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Documented human-caused mortalities in recreational fishing gear entanglement and repeated UMEs reinforce concern for this stock. Because the stock size is currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*)
Biscayne Bay Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Except for animals residing within the Southern North Carolina and Northern North Carolina Estuarine Systems (e.g., Waring *et al.* 2009), estuarine dolphins along the U.S. east coast have not previously been included in stock assessment reports. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Balmer *et al.* in press). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005).

Biscayne Bay is a shallow estuarine system located along the southeast coast of Florida in Miami-Dade county. The Bay is generally shallow (depths <5m) and includes a diverse range of benthic communities including seagrass beds, soft coral and sponge communities, and mud flats. The northern portion of the Bay (Figure 1) is surrounded by the cities of Miami and Miami Beach and is therefore heavily influenced by industrial and municipal pollution sources. The water flow in this portion of the Bay is very restricted due to the construction of dredged islands (Bialczak *et al.* 2001). In contrast, the central and southern portions of the Bay are less influenced by development and are better flushed. Water exchange with the Atlantic Ocean occurs through a broad area of grass flats and tidal channels termed the Safety Valve. The Bay extends south through Card Sound and Barnes Sound, and connects through smaller inlets to Florida Bay (Figure 1). The Biscayne Bay stock of bottlenose dolphins is bounded by Haulover Inlet to the north and Card Sound bridge to the south. This range corresponds to the extent of confirmed home ranges of bottlenose dolphins observed residing in Biscyane Bay by a long-term photo-ID study conducted by the Southeast Fisheries Science Center (Litz 2007; SEFSC unpublished data). It is likely that the range of Biscyane Bay dolphins extends past these boundaries; however, there have been few surveys outside of this range. These boundaries are subject to change upon further study of dolphin home ranges within the Biscayne Bay estuarine system and comparison to an extant photo-ID catalog from Florida Bay to the south.

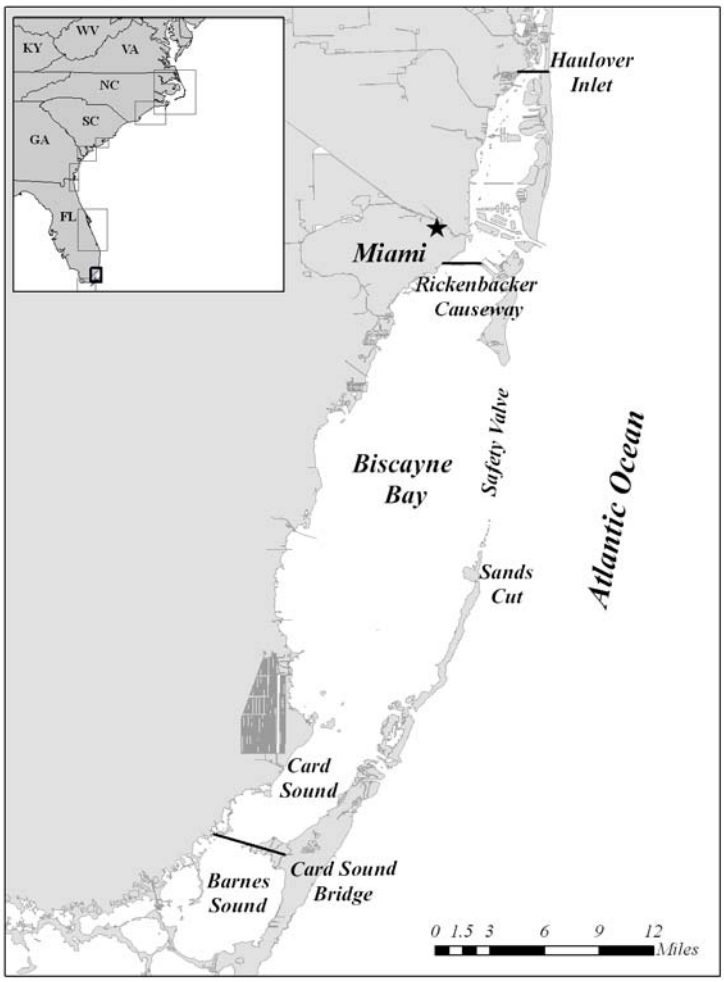

Figure 1. *Geographic extent of the Biscayne Bay stock.*

Dolphins residing within estuaries north of this stock along the southeastern coast of Florida are currently not included in any Stock Assessment Report. There are insufficient data to determine whether animals in this region exhibit affiliation to the Biscayne Bay stock, the estuarine stock further to the north in the Indian River Lagoon Estuarine System (IRLES), or are simply transient animals associated with coastal stocks. There is relatively limited estuarine habitat along this coastline; however, the Intracoastal Waterway extends north along the coast to the IRLES. It should be noted that during 2003-2007, there were 3 stranded bottlenose dolphins in this region in enclosed waters. One of these had signs of human interaction from a boat strike and another was identified as an offshore morphotype bottlenose dolphin.

Bottlenose dolphins have been documented in Biscayne Bay since the 1950's (Moore 1953). Live capture fisheries for bottlenose dolphins are known to have occurred throughout the southeastern U.S. and within Biscayne Bay during the 1950's and 1960's; however, it is unknown how many individuals may have been removed from the population during this period (Odell 1979; Wells and Scott 1999).

The Biscayne Bay bottlenose dolphin stock has been the subject of an ongoing photo-ID study conducted by the NMFS Southeast Fisheries Science Center since 1990. From 1990 to 1991, preliminary information was collected focusing on the central portion of the Bay. The survey was re-initiated in 1994, and it was expanded to include the northern portion of the Bay and south to the Card Sound Bridge in 1995 (SEFSC unpublished data; Litz 2007). Through 2007, the photo-ID catalog included 229 unique individuals. Approximately 80% of these individuals may be long-term residents with multiple sightings over the 17 years of the study (SEFSC unpublished data). Analyses of the sighting histories and associations of individuals from the Biscayne Bay photo-ID data demonstrated that there are at least 2 overlapping social groups of animals within Biscayne Bay segregated along a north/south gradient (Litz 2007).

Remote biopsy samples of Biscayne Bay animals were collected between 2002 and 2004 for analyses of population genetic structure and persistent organic pollutant concentrations in blubber. Genetic structure was investigated using both mitochondrial DNA (mtDNA) and nuclear (microsatellite) markers, and the data from Biscayne Bay were compared to data from Florida Bay dolphins to the south (Litz 2007). Within Biscayne Bay, dolphins sighted primarily in the northern half of the Bay were significantly differentiated from those sighted primarily in the southern half at the microsatellite loci but not at the mitochondrial locus. There was not sufficient genetic differentiation between these groups to indicate true population subdivision (Litz 2007). However, genetic differentiation was found between the Biscayne Bay and Florida Bay dolphins in both markers (Litz 2007). The observed genetic differences between resident animals in Biscayne Bay and those in an adjacent estuary combined with the high levels of sight fidelity observed, demonstrate that the resident Biscayne Bay bottlenose dolphins are a demographically distinct population stock.

POPULATION SIZE

The total number of bottlenose dolphins residing within the Biscayne Bay stock is unknown. An initial evaluation of the abundance of bottlenose dolphins in Biscayne Bay was conducted with aerial surveys in 1974-1975 covering predominantly the central portion of the Bay from Rickenbacker Causeway to the northern end of Card Sound. Bottlenose dolphins were observed in the Bay on 7 of 22 aerial surveys with the sightings totaling 67 individuals. Only 1 group was seen on each survey. This led the authors to conclude that there was likely 1 herd of approximately 13 animals occupying the Bay (Odell 1979). It was noted that this encounter rate was much lower than that in the adjacent Everglades National Park, and that the apparent low density of dolphins in Biscayne Bay had limited the effectiveness of the collection of live animals for display.

Between 1994 and 2007, 394 small boat surveys of Biscayne Bay were conducted for the bottlenose dolphin photo-ID study. A day's survey effort covered either the northern (Haulover Inlet to Rickenbacker Causeway), central (Rickenbacker Causeway to Sands Cut) or southern (Sands Cut to Card Sound Bridge) region of the Bay. Each area was surveyed 8-12 times per year on a monthly basis from 1994 to 2003. From 2003 to 2007, the number of surveys was lower and ranged between 4 and 8 per year, and the lowest amount of effort was expended in the southern portion of the Bay. When dolphins were encountered, estimates of group size were made, and photographs of fins were taken of as many individuals as possible. The fins were cataloged and individuals identified using standard methods (SEFSC unpublished data). There were 157 unique individuals identified in the photo-ID surveys between 2003 and 2007. However, this catalog size does not represent a valid estimate of population size because the residency patterns of dolphins in Biscayne Bay are not fully understood. It is currently not possible to develop a mark-recapture estimate of population size from the photo-ID catalog. However, research is currently underway to estimate the abundance of the Biscayne Bay stock using a photographic mark-recapture method.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate for the Biscayne Bay stock of bottlenose dolphins.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the Biscayne Bay stock of bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the Biscayne Bay stock of bottlenose dolphins is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the Biscayne Bay stock during 2003-2007 is unknown as there are no observed fisheries or estimates of total mortality. However, there was 1 documented mortality associated with the stone crab fishery in 2006. Thus, the minimum annual commercial-fishery-caused mortality for 2003-2007 is estimated as 0.2 animals per year.

Fishery Information

There have been several documented mortalities of Biscayne Bay bottlenose dolphins in crab and lobster pot fisheries. There is no systematic observer coverage of these fisheries, therefore it is not possible to quantify total mortality.

Crab and Lobster Pots

There have been 3 documented mortalities of bottlenose dolphins in Biscayne Bay associated with entanglement in crab and lobster pot fisheries. One entanglement mortality was documented in 1997 in lobster pot gear just outside of the opening of the Bay to the Atlantic Ocean on the eastern edge of the Safety Valve area. In 2002, an entanglement mortality was observed in the central portion of the Bay in a stone crab pot. Finally, in 2006 there was an entanglement mortality of a known Biscayne Bay resident animal, also in a stone crab pot. This entanglement occurred in the northern portion of the Bay.

Other Mortality

There have been 2 mortalities of known resident Biscayne Bay bottlenose dolphins associated with ingestion and/or entanglement of recreational fishing gear including hooks and monofilament line. These mortalities occurred during 1990 and 1999.

There were 3 additional stranded animals occurring inside Biscayne Bay between 2003 and 2007 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). The first occurred in 2004, and it was confirmed to be of the offshore morphotype by genetic testing and therefore not a Biscayne Bay resident. Two animals stranded in 2006, and 1 of these was a known Biscayne Bay resident. No definitive evidence of human interaction was detected for either of these animals; however human interaction could not be ruled out in either case.

The nearshore and estuarine habitats occupied by dolphins are adjacent to areas of high human population and some are highly industrialized. 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 pollutant concentrations in blubber, particularly near Charleston, South Carolina, and Beaufort, North Carolina (Hansen *et al.* 2004). The concentrations found in male dolphins from both of these sites exceeded toxic threshold

values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). A study of persistent organic pollutants in bottlenose dolphins of Biscayne Bay demonstrated a strong geographic gradient in pollutant concentrations between dolphins with sighting histories primarily in the northern, more polluted areas compared to dolphins with ranges in the southern portion of the Bay (Litz *et al.* 2007). The observed tissue concentrations of polychlorinated biphenyls (PCBs) for male animals from the northern Bay were 5 times higher than those in southern Biscayne Bay and were also higher than those of dolphins from other Atlantic estuaries including Beaufort, North Carolina, Charleston, South Carolina, Indian River Lagoon, Florida, and Florida Bay (Litz *et al.* 2007). These findings demonstrate differential exposure of bottlenose dolphins to pollutants through the food chain on a very fine spatial scale within Biscayne Bay and between estuaries.

STATUS OF STOCK

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

The status of the Biscayne Bay stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. The total human-caused mortality and serious injury for this stock is unknown and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Documented human-caused mortalities in recreational fishing gear entanglement and ingestion of gear reinforce concern for this stock. Because the stock size is currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*)
Florida Bay Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Except for animals residing within the Southern North Carolina and Northern North Carolina Estuarine Systems (e.g., Waring *et al.* 2007), estuarine dolphins along the U.S. east coast have not previously been included in stock assessment reports. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Balmer *et al.* in press). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005).

Florida Bay is a shallow estuarine system that lies between the mainland of Florida and the Florida Keys and encompasses 2,200 km^2 of interconnected basins, grassy mud banks and mangrove islands. Florida Bay is bordered by the Florida mainland to the north, by the Florida Keys and Atlantic Ocean to the southeast, and by the Gulf of Mexico to the west. The western boundary of the Everglades National Park is generally considered to be the boundary between Florida Bay and the Gulf of Mexico. Here, Barnes Sound is not considered to be part of Florida Bay (Figure 1). Florida Bay was historically fed by runoff from the Everglades through marsh-like prairies called sloughs and a number of nearby creeks or inlets. The Bay connects through smaller inlets to Biscayne Bay, between Blackwater Sound and Barnes Sound. Freshwater flow from the Everglades is a major influence on the conditions within the Bay, particularly since tides have little effect on water levels due to mud banks which restrict water flow (Fourqurean and Robblee 1999).

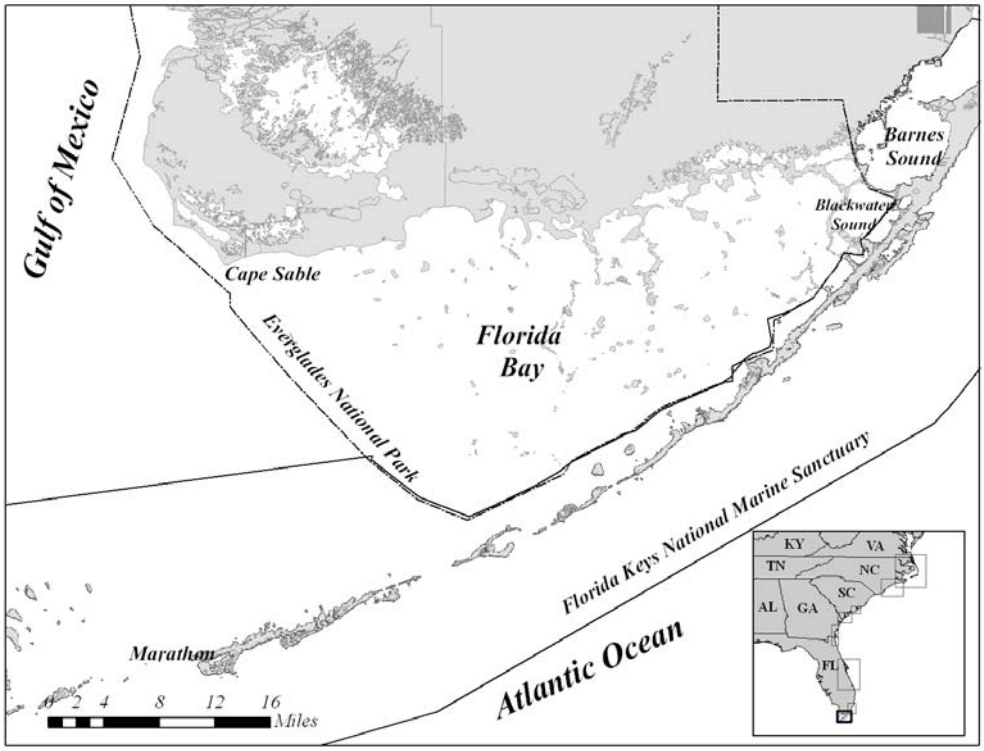

Figure 1. *Geographic extent of the Florida Bay stock. The boundaries of Everglades National Park and Florida Keys National Marine Sanctuary are shown.*

The Florida Bay resident stock of bottlenose dolphins is considered to occur both within the bounds of Florida Bay and within the Gulf of Mexico-side portion of the Florida Keys National Marine Sanctuary (FKNMS) southwest to Marathon, Florida (Figure 1). The acutal range of the resident animals is unknown, but it likely extends

beyond the boundaries of Florida Bay at times. For example, the range of Florida Bay dolphins may extend north into Barnes Sound; however, there have been few surveys of this area. In addition, it is likely that transient animals occur within the Florida Bay boundaries including perhaps offshore morphotype animals that move onshore from nearby oceanic waters. These boundaries are subject to change upon further study of dolphin home ranges within the Florida Bay estuarine system and comparison to an extant photo-ID catalog from Biscayne Bay to the north.

Live capture fisheries for bottlenose dolphins are known to have occurred throughout the southeastern U.S. and within Florida Bay. An active bottlenose dolphin live-capture fishery operating between 1962 and 1973 in the Florida Keys permanently removed 70 bottlenose dolphins for captive display in marine parks. Thirteen of these dolphins were confirmed removals from Florida Bay, and it is likely the remaining animals were from Florida Bay as well, but the absence of specific geographic data in the marine mammal inventory makes it difficult to confirm the remaining removal locations. No dolphins have been removed from Florida Bay or the Florida Keys since 1973 (NMFS Marine Mammal Inventory, July 24, 2004).

During 1995-1997, aerial surveys were conducted in Florida Bay to census bird populations, and opportunistic sightings of bottlenose dolphins were recorded. While these surveys did not estimate the abundance of bottlenose dolphins, the surveys documented the presence of dolphins in Florida Bay throughout the year (McClellan *et al.* 2000). Biopsy sampling was conducted in 1998 and 2002 for contaminant analyses (Fair *et al.* 2003). Sub-samples were later used for genetic analysis, and this study found significant genetic differentiation between Florida Bay and Biscayne Bay to the north (Litz 2007)

The Florida Bay bottlenose dolphin stock has been the subject of an ongoing photo-ID study by the Dolphin Ecology Project since 1999. From 1999 to 2000, preliminary information was collected focusing on the eastern, Atlantic, and central areas of the Bay, and in 2001 the surveys were expanded to include the western portion of the Bay including the region of transition to the Gulf of Mexico. Typically, photo-ID surveys were conducted during the 2 seasons of most extreme rainfall levels in Florida Bay, summer (the wet season, May-October) and winter (the dry season, November-April), allowing for the assessment of seasonal variation in the distribution of dolphins (Engleby *et al.* 2002). Surveys were conducted by a small vessel using standard photo-ID methods. Through 2007, the photo-ID catalog included 577 unique individuals. Sighting data confirm that dolphins range throughout the Bay and are present year-round (Engleby, unpublished data.)

During the summer (June-August) from 2002 to 2005, a study to investigate top predator (sharks and dolphins) distribution and foraging ecology was conducted in Florida Bay. The sighting histories of 437 unique individual dolphins further confirmed that dolphins are present in all areas of the Bay and demonstrate high individual site and foraging tactic fidelity (Torres 2007).

POPULATION SIZE

The first mark-recapture abundance survey of bottlenose dolphins in Florida Bay was conducted during May 2003 using photo-ID methods (Read *et al.*, in review). This survey resulted in a best estimate for abundance of bottlenose dolphins in Florida Bay of 514 (CV=0.17; Read *et al.*, in review). This estimate accounts for the proportion of the population with unmarked fins. The mark-recapture abundance estimate is comparable to a direct count of known individuals from a long-term photo-ID catalog (n=577) and work by Torres (2007) which documented 437 individuals during summer months. Each of these counts or estimates of population size does not effectively distinguish resident from non-resident animals in the Bay and so are likely overestimates of the resident population.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for this stock is 514 (CV=0.17) obtained from the mark-recapture survey (Read *et al.* in review). The minimum population estimate for the Florida Bay stock of bottlenose dolphins is therefore 447.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the Florida Bay stock of bottlenose dolphins is 447. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the Florida Bay stock of bottlenose dolphins is 4.5.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no documented reports of fishery-related mortality or serious injury to this stock between 2003 and 2007. However, 1 bottlenose dolphin was entangled in a lobster pot and released alive in unknown condition.

Fishery Information

Most of Florida Bay lies within the boundaries of the Everglades National Park with a smaller portion that lies within the FKNMS. Commercial fishing in the Everglades National Park is prohibited. The majority of recreational fishing is hook and line, although dip nets, cast nests and landing nets are also used. The predominant commercial fishery in the FKNMS is stone crab and spiny lobster. There are no documented mortalities of bottlenose dolphins in crab or lobster pot fisheries in Florida Bay between 2003 and 2007.

Crab and Lobster Pots

During 2003-2007, 1 bottlenose dolphin was reported entangled in a lobster pot in the southern, FKNMS portion of Florida Bay and was released alive (condition unknown). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab and lobster pots.

Other Mortality

From 2003 to 2007, there were 7 additional stranded bottlenose dolphins in the boundaries of the Florida Bay stock (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 10 November 2008). Five of these animals stranded dead, but it could not be determined if there was evidence of human interactions for these cases. One animal was initially observed alive and entangled in debris associated with Hurricane Wilma, and the animal died after being released. In addition, 1 animal confirmed to be from the Dolphin Ecology Project photo-ID catalog was observed out of habitat and was captured, relocated and released (Southeast Region Stranding Network). The majority of stranding reports came from the portion of Florida Bay contained within the FKNMS, likely associated with the higher human population in this area. Aside from the 1 animal, it is unknown if stranded animals were from the Florida Bay stock or drifted in from adjacent waters. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fishery interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Over the past several decades, large areas of the Everglades ecosystem have been significantly altered by engineered flood control and water distribution for urban and agricultural development. These alterations of freshwater flow into Florida Bay have resulted in increased algal blooms, mangrove and seagrass die-offs, trophic community shifts and changes in salinity. In response, multiple federal, state, county and local agencies are working on a Comprehensive Everglades Restoration Program with the objective of restoring the natural flows of water, water quality and more natural hydro-periods within the ecosystem. As one of the largest ecosystem restoration efforts in the United States, projects are on-going and will likely impact physical and biotic parameters in Florida Bay. While it is unknown how alterations in water flow historically affected bottlenose dolphin abundance and distribution, it is known that bottlenose dolphins are a good indicator species to monitor the future health of this ecosystem due to the overlap between dolphin foraging behavior and abundant fish populations (see Torres and Urban 2005).

There is some concern about the potential effect of contaminants on the health of bottlenose dolphins in Florida Bay, due to their proximity to large agricultural and industrial operations. Contaminants of concern include persistent organic pollutants and heavy metals such as mercury. The agricultural pesticide endosulfan is of particular concern, with the majority (76%) of endosulfan used in the southeast discharging into the Everglades and Florida Bay watershed (Pait *et al.* 1992). A study in 2003 collected remote biopsy samples and provided the first baseline

data on levels of exposure to toxic persistent organic contaminants for dolphins in Florida Bay. Pesticides such as endosulfan were found at low or non-detectable concentrations (Fair *et al.* 2003). A review of available organochlorine exposure data from both dart biopsy and live-capture health assessment studies along the southeast U.S. coast indicate that contaminant levels were lowest for dolphins sampled in Florida Bay when compared to all other sites in the southeast U.S. Measured concentrations of total DDTs were lowest for dolphins sampled in Florida Bay. Reported total PCB concentrations were also lowest in Florida Bay and this was the only location in the southeast where samples fell below the toxic threshold value for total PCBs (Schwacke *et al.* 2004). There are no estimates of indirect human-caused mortality from pollution or habitat degradation.

STATUS OF STOCK

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

The status of the Florida Bay stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and the total fishery-related mortality and serious injury for this stock is unknown, but given the lack of stranded animals with evidence of fishery interactions and the low level of commercial fishery activity within the stock boundaries, it is likely to be less than 10% of PBR, and can be considered to be insignificant and approaching zero mortality and serious injury rate. Therefore, NMFS does not consider the Florida Bay stock of bottlenose dolphins to be strategic.

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