December 2009

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.* 2008). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005).

The 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,c). 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.

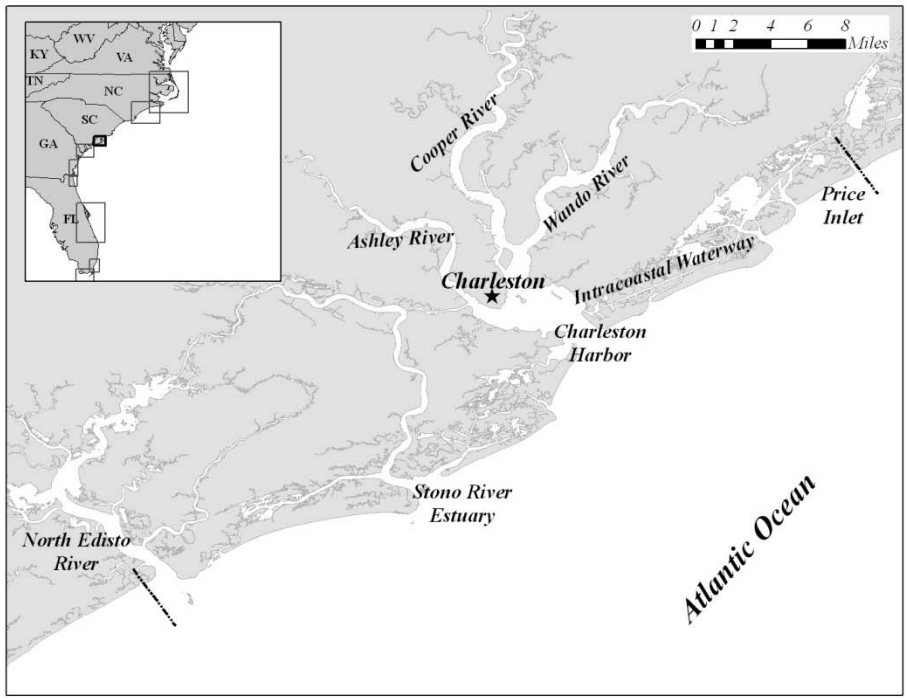

Figure 1. *Geographic extent of the Charleston Estuarine System (CES) stock. Dashed lines denote the boundaries.*

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 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 biphenyls (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.

REFERENCES CITED

Adams, J., M. Houde, D. Muir, T. Speakman, G. Bossart and P. Fair 2008. Land use and the spatial distribution of perfluoroalkyl compounds as measured in the plasma of bottlenose dolphins (*Tursiops truncatus*). Mar. Environ. Res. 66: 430-437.

Balmer, B.C., R.S. Wells, S.M. Nowacek, D.P. Nowacek, L.H. Schwacke, W.A. McLellan, F.S. Scharf, T.K. Rowles, L.J. Hansen, T.R. Spradlin and D.A. Pabst 2008. Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. J. Cetacean Res. Manage. 10(2): 157-167

Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

Bossart, G.D., T.A. Romano, M.M. Peden-Adams, C.D. Rice, P.A. Fair, J.D. Goldstein, D. Kilpatrick, K. Cammen and J.S. Reif 2008. Hematological, biochemical, and immunological findings in Atlantic bottlenose dolphins (*Tursiops truncatus*) with orogenital papillomas. Aquatic Mammals 34(2): 167-177.

Burdett, L.G. and W.E. McFee 2004. Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the Atlantic blue crab fishery categorisation. J. Cetacean Res. Manage. 6: 231-240.

Caldwell, M. 2001. Social and genetic structure of bottlenose dolphin (*Tursiops truncatus*) in Jacksonville, Florida. Ph.D. thesis. University of Miami. 143 pp.

Fair, P.A., G. Mitchum, T.C. Hulsey, J. Adams, E. Zolman, W. McFee, E. Wirth and G.D. Bossart 2007. Polybrominated diphenyl ethers (PBDEs) in blubber of free-ranging bottlenose dolphins (*Tursiops truncatus*) from two southeast Atlantic estuarine areas. Arch. Environ. Contam. Toxicol. 53: 483-494.

Gubbins, C. 2002a. Association patterns of resident bottlenose dolphins (*Tursiops truncatus*) in a South Carolina estuary. Aquatic Mammals 28: 24-31.

Gubbins, C. 2002b. Use of home ranges by resident bottlenose dolphins (*Tursiops truncatus*) in a South Carolina estuary. J. Mamm. 83(1): 178-187.

Gubbins, C.M. 2002c. The dolphins of Hilton Head: Their natural history. University of South Carolina Press, Columbia. 69 pp.

Gubbins, C.M., M. Caldwell, S.G. Barco, K. Rittmaster, N. Bowles and V. Thayer 2003. Abundance and sighting patterns of bottlenose dolphins (*Tursiops truncatus*) at four northwest Atlantic coastal sites. J. Cetacean Res. Manage. 5(2): 141-147.

Hansen, L.J., L.H. Schwacke, G.B. Mitchum, A.A. Hohn, R.S. Wells, E.S. Zolman and P.A. Fair 2004. Geographic variation in polychlorinated biphenyl and organochlorine pesticide concentrations in the blubber of bottlenose dolphins from the U.S. Atlantic coast. Sci. Total Eviron. 319: 147-172.

Houde, M., T.A.D. Bujas, J. Small, R.S. Wells, P.A. Fair, G.D. Bossart, K.R. Solomon and D.C.G. Muir 2006a. Biomagnification of perfluoroalkyl compounds in the bottlenose dolphin (*Tursiops truncatus*) food web. Env. Sci. and Tech. 40: 4138-4144.

Houde, M., G. Pacepavicius, R.S. Wells, P.A. Fair, R.J. Letcher, M. Alaee, G.D. Bossart, A.A. Hohn, K.R. Solomon and D. Muir 2006b. Polychlorinated biphenyls and hydroxylated polychlorinated biphenyls in plasma of bottlenose dolphins (*Tursiops truncatus*) from the Western Atlantic and the Gulf of Mexico. Env. Sci. and Tech. 40: 5860-5866.

Johnson-Restrepo, K.K. B., R. Addink and D.H. Adams 2005. Polybrominated diphenyls in a marine food web of coastal Florida. Env. Sci. and Tech. 39: 8243-8250.

Kannan, K., K. Senthilkumar, B.G. Loganathan, S. Takahashi, D.K. Odell and S. Tanabe 1997. Elevated accumulation of tributylin and its breakdown products in bottlenose dolphins (*Tursiops truncatus*) found stranded along the U.S. Atlantic and Gulf coasts. Env. Sci. and Tech. 31: 296-301.

Kuehl, D.W. and R. Haebler 1995. Organochlorine, organobromine, metal, and selenium residues in bottlenose dolphins (*Tursiops truncatus*) collected during an unusual mortality event in the Gulf of Mexico, 1990. Arch. Environ. Contam. Toxicol. 28(4): 494-499.

Litz, J.A. 2007. Social structure, genetic structure, and persistent organohalogen pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida. Ph.D. thesis. University of Miami. 140 pp.

Mazzoil, M., S.D. McCulloch and R.H. Defran 2005. Observations on the site fidelity of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. Florida Scientist 68(4): 217-226.

McFee, W.E. and L.G. Burdett 2007. Spatial and temporal analysis of bottlenose dolphin strandings in South Carolina, 1992-2005. NOAA Tech. Memo. NOS-NCCOS-46. 12 pp.

McFee, W.E., J.H. Schwacke, M.K. Stolen, K.D. Mullin and L.H. Schwacke in press. Investigation of growth phases for bottlenose dolphins using a Bayesian modeling approach. Mar. Mamm. Sci.

Montie, E.W., P.A. Fair, G.D. Bossart, G.B. Mitchum, M. Houde, D.C.G. Muir, R.J. Letcher, W.E. McFee, V.R. Starczak, J.J. Stegeman and M.E. Hahn 2008. Cytochrome P4501A1 expression, polychlorinated biphenyls and hydroxylated metabolites, and adipocyte size of bottlenose dolphins from the southeastern United States. Aquat. Tox. 86: 397-412.

Petricig, R.O. 1995. Bottlenose dolphins (*Tursiops truncatus*) in Bull Creek, South Carolina. Ph.D. thesis. University of Rhode Island. 281 pp.

Schwacke, L., A.J. Hall, R.S. Wells, G.D. Bossart, P. Fair, A.A. Hohn, P.R. Becker, J. Kucklick, G.B. Mitchum and P.E. Rosel 2004. Health and risk assessment for bottlenose dolphin (*Tursiops truncatus*) populations along the southeast United States coast: Current status and future plans. paper SC/56/E20 presented to the IWC Scientific Committee, Sorrento, Italy. 15 pp.

Scott, G.P., D.M. Burn and L.J. Hansen 1988. The dolphin dieoff: Long-term effects and recovery of the population. Conference proceedings, Oceans '88. IEEE Cat. No. 88-CH2585-8.

Sellas, A.B., R.S. Wells and P.E. Rosel 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conservation Genetics 6(5): 715-728.

Sloan, P.E. 2006. Residency patterns, seasonality and habitat use among bottlenose dolphins, *Tursiops truncatus*, in the Cape Romaine National Wildlife Refuge, SC. M.Sc. thesis. University of North Carolina, Wilmington. 66 pp.

Speakman, T., E. Zolman, J. Adams, R.H. Defran, D. Laska, L. Schwacke, J. Craigie and P. Fair 2006. Temporal and spatial aspects of bottlenose dolphin occurrence in coastal and estuarine waters near Charleston, South Carolina. NOAA Tech. Memo. NOS-NCCOS-37. 50 pp.

Vecchione, A., M.M. Peden-Adams, T.A. Romano and P.A. Fair 2008. Recent cytokine findings and implications toward health assessment of the bottlenose dolphin (*Tursiops truncatus*). Aquatic Mammals 34(1): 93-101.

Wade, P.R. and R.P. Angliss 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Waring, G.T., E. Josephson, C.P. Fairfield-Walsh and K. Maze-Foley 2007. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2007. NOAA Tech Memo. NMFS NE 205. 415 pp.

Wells, R.S., M.D. Scott and A.B. Irvine 1987. The social structure of free ranging bottlenose dolphins. Pages 247-305 *in*: H. Genoways, (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York.

Young, R.F. and H.D. Phillips 2002. Primary production required to support bottlenose dolphins in a salt marsh creek system. Mar. Mamm. Sci. 18(2): 358-373.

Zolman, E.S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River estuary, Charleston County, South Carolina, U.S.A. Mar. Mamm. Sci. 18: 879-892.