April 2014

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of common bottlenose dolphins 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 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 *et al.* 2012), 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 in coastal and estuarine areas along the Atlantic coast (Rosel *et al.* 2009), and between those biopsied in coastal and estuarine waters at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005).

The estuarine habitat within and around the Charleston, South Carolina, area is comprised of both developed and undeveloped areas. 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 Intracoastal Waterway (ICW) consists of miles of undeveloped salt marshes interspersed with developed suburban areas, and it has the least amount of open water habitat.

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 little likelihood that the Stono River Estuary included the entire home range of a dolphin, as individual resident dolphins were observed in other areas, including the North Edisto River and Charleston Harbor.

Satellite telemetry of two female dolphins captured in the Stono River Estuary in October 1999 supported these photo-ID findings. The tag on each dolphin remained functional through January 2000. The first female, along with her dependent calf, visited Charleston Harbor immediately post-capture and later made several forays west to the vicinity of the North Edisto River but for the most part restricted her movements to the lower Stono River Estuary. In contrast, the second female moved frequently between the Stono River Estuary and Charleston Harbor, but not beyond these two areas. These results illustrate the limited range of these dolphins and the connective nature of the areas within the Charleston region (NOAA/NOS/NCCOS unpublished data). Over 30 additional dolphins have been fitted with VHF tags as a part of capture-release health assessments in 1999 (7 dolphins), 2003 (12 dolphins), and 2005 (16 dolphins). Dolphins were captured in the Stono River Estuary, Charleston Harbor, and the Ashley and Wando Rivers. Tagged dolphins were readily relocated within the confines of the Charleston estuarine system and were regularly tracked up to 93 days post-release (NOAA/NOS/NCCOS unpublished data). Again these data underscore the resident nature of dolphins in this region.

Speakman *et al.* (2006) summarized studies carried out from 1994-2003 on bottlenose dolphins throughout the Charleston estuarine system. 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 this area. 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 area as a single 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). Also, findings from photo-ID studies indicated that resident dolphins in this stock may 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).

Laska *et al.* (2011) investigated movements of dolphins between estuarine and coastal waters in the Charleston

estuarine system area by conducting boat-based, photo-ID surveys along 33 km of nearshore coastal waters adjacent to the Stono River Estuary and Charleston Harbor during 2003-2006. Sighting locations as well as all historical (1994-2002) sighting locations were used to classify individuals into a coastal (60% or more of sightings in coastal waters) or estuarine (60% or more of sightings in estuarine waters) community. Most dolphins (68%) identified during the study were classified as coastal, 22% were classified as estuarine, and the remaining 10% showed no preference. Estuarine dolphins were sighted along the coast 1-15 times; the majority of estuarine dolphins (74%) were sighted 1-4 times. The majority (69%) of sightings along the coast were mixed groups of estuarine and coastal dolphins. This study demonstrated that the resident animals utilize nearshore coastal waters as well as estuarine waters, and that estuarine and coastal dolphins frequently interact in this area (Laska *et al.* 2011).

The Charleston Estuarine System (CES) Stock is therefore centered near Charleston, South Carolina. It is bounded to the north by Price Inlet and includes a stretch of the ICW approximately 13 km east-northeast of Charleston Harbor. It continues through Charleston Harbor and includes the main channels and creeks of the Ashley, Cooper and Wando Rivers. The CES Stock also includes all estuarine waters from the Stono River Estuary, approximately 20 km south-southwest of Charleston Harbor, to the North Edisto River another 20km to the west-southwest, and all estuarine waters and tributaries of these rivers. Finally, the CES Stock also includes 1 km of nearshore coastal waters from Price Inlet to the North Edisto River (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 boundaries of the CES Stock are defined based on long-term photo-ID studies and telemetry work (Speakman *et al.* 2006; Adams *et al.* 2008; Laska *et al.* 2011). The CES Stock boundaries are subject to change upon further study of dolphin residence patterns in estuarine waters of North Carolina, South Carolina and Georgia.

POPULATION SIZE

Speakman *et al.* (2010) conducted seasonal (January, April, July, October), photo-ID, mark-recapture surveys during 2004-2006 in the estuarine and coastal waters near Charleston including the Stono River Estuary, Charleston Harbor, and the Ashley, Cooper and Wando Rivers. Pollock's robust design model was applied to the mark-recapture data to estimate abundance. Estimates were adjusted to include the 'unmarked' as well as 'marked' portion of the population for each season. Winter estimates provided the best estimate of the resident estuarine population as transient animals are not thought to be present during winter. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates greater than 8 years old are deemed unreliable, and therefore, 2004 abundance estimates were not included. The average abundance from January 2005 and January 2006 was 289 (CV=0.03). It is important to note this estimate did not cover the entire range of the CES Stock, and therefore the abundance estimate is negatively biased.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). Though negatively biased, the best estimate for the CES Stock is 289 (CV=0.03). The resulting minimum population estimate is 281.

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 281. 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 2.8.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury within the CES Stock during 2007-2011 is unknown. Interactions were documented with crab pot gear; however, it is not possible to estimate the total number of interactions or mortalities associated with crab pots since there is no systematic observer program.

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998; Andersen *et al*. 2008; NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*". Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fishery Information

There is a potential for the CES Stock to interact with the Category II Atlantic blue crab trap/pot fishery (Appendix III). The only documented reports of fishery-related mortality or serious injury to this stock are associated with the blue crab trap/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 2007 and 2011, 1 bottlenose dolphin in the CES interacted with a crab pot (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 13 September 2012). This animal was disentangled from crab pot gear and released alive without serious injury during 2011 (Maze-Foley and Garrison in prep.). The released animal was included in the stranding database (see Table 1). From 2004 to 2006, 4 bottlenose dolphins in the CES were entangled in crab pot gear. These animals were released alive from entangling gear and were not believed to be seriously injured. 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 43 times as of December 2012 (NOAA/NOS/NCCOS unpublished data).

Other Mortality

There were 84 strandings reported in the CES during 2007-2011 (NOAA National Marine Mammal Health and Stranding Response Database, unpublished data, accessed 13 September 2012; Table 1). Evidence of human interaction was found for 5 animals (2 of the 5 had evidence of a fisheries interaction); no evidence of human interaction was found for 41 animals; and for the remaining 40 animals, it could not be determined if there was evidence of human interaction. In addition there was an at-sea observation in 2007 of a calf with a strap around its head, and this animal was considered to be seriously injured (Maze-Foley and Garrison in prep.). Stranding data underestimate the extent of human-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in human interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement, boat-strike or other human interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interactions.

Table 1. Bottlenose dolphin strandings occurring in the Charleston Estuarine System, South Carolina from 2007 to 2011, as well as number of strandings for which evidence of human interactions was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interactions. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 13 September 2012). Please note human interaction does not necessarily mean the interaction caused the animal's death.

Stock	Category	2007	2008	2009	2010	2011	Total
Charleston Estuarine System	Total Stranded	16	9	14	23	24[c]	86
	Human Interaction						
	---Yes	1[a]	0	0	2[b]	2[d]	5
	---No	10	1	6	11	13	41
	---CBD	5	8	8	10	9	40

[a] This carcass was mutilated post-mortem by a member of the public.
[b] This total includes 1 animal that was disentangled and released alive with serious injuries due to interaction with unidentified fishing gear (Maze-Foley and Garrison in prep.).
[c] This total includes 10 animals that were part of the 2011 UME event in South Carolina.
[d] This total includes 1 animal (mortality) struck by a boat, and 1 that was disentangled from crap pot gear and released alive, without serious injury (Maze-Foley and Garrison in prep.).

An Unusual Mortality Event (UME) was declared in South Carolina during February-May 2011. Ten strandings assigned to the CES Stock were considered to be part of the UME. The cause of this UME is still under investigation. 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 from 1994 through 2012 in the Charleston area was checked against any strandings in the CES for which the animal could be identified (Table 2). Thirty-one (14%) of the 215 stranded dolphins were identifiable, 24 (77%) of which had been previously identified as resident estuarine dolphins belonging to the CES Stock (NOAA/NOS/NCCOS unpublished data). Seven additional dolphins (23%) 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 86% 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.

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 (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 concentrations of several contaminants in bottlenose dolphins from the Charleston area (Kannan *et al.* 1997). McFee *et al.* (2010) 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.

High concentrations of polychlorinated biphenyls (PCBs) and DDT have been found in the blubber of bottlenose dolphins sampled near Charleston (Kuehl and Haebler 1995; Houde *et al.* 2006). 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). 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.

Unlike PCBs 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). 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.

Orogenital papillomas have been reported in bottlenose dolphins from the Charleston area. 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.

Persistent organic pollutant (PCBs, chlordanes, mirex, DDTs, HCB and dieldrin) and polybrominated diphenyl ether concentrations were determined from bottlenose dolphin blubber samples from 14 locations, including the CES, along the U.S. Atlantic and Gulf coasts and Bermuda (Kucklick *et al.* 2011). Dolphins from both rural and urban estuarine and coastal waters were sampled. Dolphins sampled from the CES area had relatively high concentrations of some pollutants, like PBDEs, HCB, dieldrin and chlordanes, and more intermediate concentrations of PCBs, mirex and DDTs, when compared to dolphins sampled from the other 13 locations (Kucklick *et al.* 2011).

There are no estimates of indirect human-caused mortality from pollution or habitat degradation for the CES Stock. Studies of the health of bottlenose dolphins in this area are ongoing (Schwacke, pers. comm.).

STATUS OF STOCK

Bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act. However, because the abundance of the CES Stock is small and relatively few mortalities and serious injuries would exceed PBR, NMFS considers this to be a strategic stock under the Marine Mammal Protection Act. PBR for the CES Stock is 2.8 and so the zero mortality rate goal, 10% of PBR, is 0.3. The documented annual average human-caused mortality for this stock for 2007 – 2011 ranged between 0 and 0.2. However, the total impact of crab trap/pot fisheries on estuarine bottlenose dolphins is currently unknown, but has been shown previously to be considerable in this area (Burdett and McFee 2004). Therefore, the documented mortalities must be considered minimum estimates of total fishery-related mortality. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching a zero mortality and serious injury rate. The status of this stock relative to OSP is unknown. There are insufficient data to determine the population trends for this stock.

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