May 2016

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the western North Atlantic, the coastal morphotype of common bottlenose dolphins is continuously distributed in nearshore coastal and estuarine waters along the U.S. Atlantic coast south of Long Island, New York, around the Florida peninsula. 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coast (Rosel *et al.* 2009), and between those biopsied in coastal and estuarine waters at the same latitude (NMFS unpublished data).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.

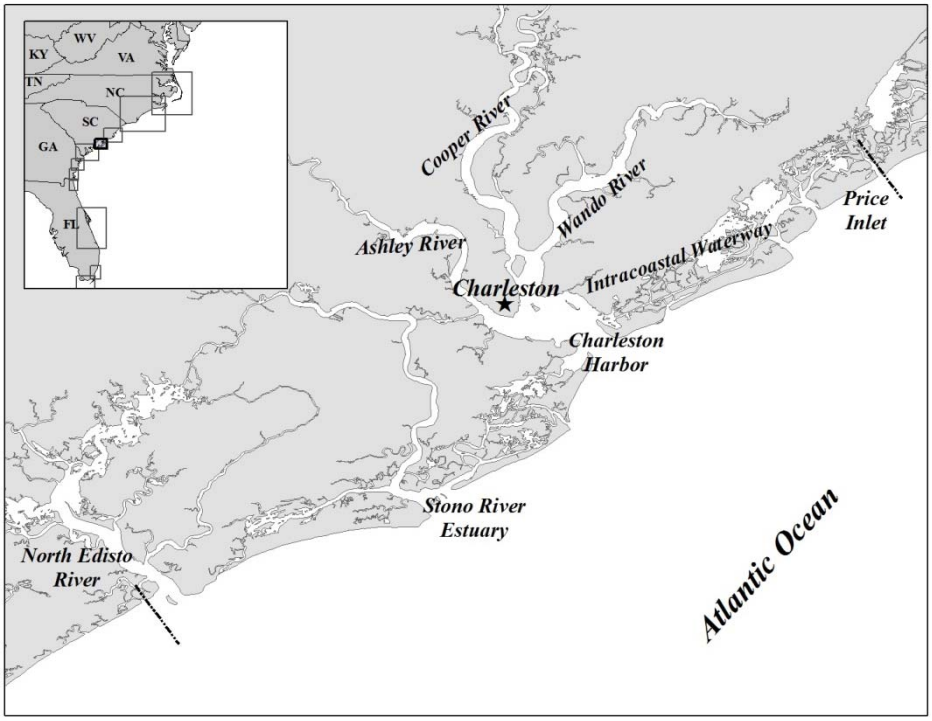

Figure 1. *Geographic extent of the Charleston Estuarine System (CES) stock. Dashed lines denote the boundaries.*

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

The total number of common bottlenose dolphins residing within the CES Stock is unknown because previous estimates are greater than 8 years old. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates greater than 8 years old are deemed unreliable to determine the current PBR. 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. 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 was negatively biased.

Minimum Population Estimate

The current minimum population estimate is unknown. 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).

Current Population Trend

There are insufficient data to determine the population trends for this stock. Speakman *et al.* (2010) provided abundance estimates from 2004 to 2006 but did not evaluate an interannual trend.

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 currently undetermined. 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 common bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5 because this stock is of unknown status.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the CES Stock during 2009–2013 is unknown because this stock is known to interact with an unobserved fishery (see below). No mortality or serious injury was documented from human-caused actions during 2009–2013.

Fishery Information

This stock interacts with the Category II commercial 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 and unidentified fishing gear.

Atlantic Blue Crab Trap/Pot

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 common 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 2009 and 2013, 2 bottlenose dolphins in the CES were documented as entangled in commercial blue crab trap/pot gear (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 13 September 2012). Both of these animals were disentangled and released alive without serious injury, 1 during 2011 and 1 during 2012 (Maze-Foley and Garrison in prep a,b). The released animals were included in the stranding database (see Table 1). From 2004 to 2008, 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). Because there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Other Mortality

There were 102 strandings reported in the CES during 2009–2013 (NOAA National Marine Mammal Health and Stranding Response Database, unpublished data, accessed 11 June 2014; Table 1). It could not be determined if there was evidence of human interaction (HI) for 46 of these strandings, and for 47 it was determined there was no evidence of human interaction. The remaining 9 showed evidence of human interactions, 3 of which were fisheries interactions (FIs). All 3 FIs were live animals that were disentangled and released. As noted above, 2 animals were

disentangled from trap/pot gear and released alive without serious injury (Maze-Foley and Garrison in prep a,b). The third was released alive with serious injuries after being disentangled from gear (rope wrapped around the base of its flukes) that was not identified to a specific fishery (Maze-Foley and Garrison in prep a). Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al.* 2012; Wells *et al.* 2015). Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al.* 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

Table 1. Common bottlenose dolphin strandings occurring in the Charleston Estuarine System, South Carolina from 2009 to 2013, 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 11 June 2014). Please note human interaction does not necessarily mean the interaction caused the animal's death.

Stock	Category	2009	2010	2011	2012	2013	Total
Charleston Estuarine System	Total Stranded	13	22	24[a]	20	23	102
	Human Interaction						
	---Yes	0	2[b]	2[c]	4[d]	1	9
	---No	5	11	13	8	10	47
	---CBD	8	9	9	8	12	46

[a] This total includes 10 animals that were part of the 2011 UME event in South Carolina.
[b] This total includes 1 FI in which a dolphin was disentangled and released alive with serious injuries due to interaction with unidentified fishing gear.
[c] This total includes 1FI that was disentangled from commercial blue crab trap/pot gear and released alive without serious injury.
[d] This total includes 1FI that was disentangled from commercial blue crab trap/pot gear and released alive without serious injury.

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 was undetermined. A UME was declared in the summer of 2013 for the mid-Atlantic coast from New York to Brevard County, Florida. Beginning in July 2013, common bottlenose dolphins have been stranding at elevated rates. The total number of stranded bottlenose dolphins from New York through North Florida (Brevard County) as of mid-October 2014 (1 July 2013 - 19 October 2014) was ~1546. Morbillivirus has been determined to be the cause of the event. Most strandings and morbillivirus positive animals have been recovered from the ocean side beaches rather than from within the estuaries, suggesting that at least so far coastal stocks have been more impacted by this UME than estuarine stocks. However, the UME is still ongoing as of December 2014 when this report was drafted, and work continues to determine the effect of this event on all bottlenose dolphin stocks in the Atlantic.

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.

HABITAT ISSUES

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 chemical contaminant concentrations and potential associated health risks for bottlenose dolphins in the CES. An early study measured blubber concentrations of persistent organic pollutants (POPs) and found that samples from male dolphins near Charleston exceeded toxic threshold values that could potentially result in adverse effects on health or reproductive rates (Hansen *et al.* 2004; Schwacke *et al.* 2004). In addition, Fair *et al.* (2007) found that mean total polybrominated diphenyl ethers (PBDE) 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 Adams *et al.* (2014) confirmed that PBDE concentrations were higher in CES dolphins that utilized more urbanized/industrialized portions of the area. A broader study by Kucklick *et al.* (2011) demonstrated that while concentrations of some emerging pollutants such as PBDEs were relatively high for dolphins sampled from the CES area as compared to dolphins sampled from 13 other locations long the U.S. Atlantic and Gulf coasts and Bermuda, concentrations of legacy pollutants with well-established toxic effects such as polychlorinated biphenyls (PCBs) and DDT in CES dolphins were more intermediate as compared to the other coastal locations (Kucklick *et al.* 2011).

Perfluoroalkyl compounds (PFCs) have also been measured from the plasma of bottlenose dolphins from the CES area (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.

Morbillivirus is a concern for dolphin stocks, particularly long the U.S. Atlantic coast where the disease has been implicated in UMEs. Serum samples from dolphins within the CES area have been found to be negative for titers to both dolphin morbillivirus and porpoise morbillivirus (Rowles *et al.* 2011, Bossart *et al.* 2010), indicating that these dolphins have not been exposed to morbillivirus in recent years. Therefore, CES dolphins likely have little protective antibody titers and could be vulnerable to infection if the disease were to be introduced into the stock.

STATUS OF STOCK

Common 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 currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, NMFS considers this to be a strategic stock under the MMPA. There was no documented human-caused mortality or serious injury for this stock during 2009–2013. However, 2 recent entanglements (non-serious injuries) and entanglements in prior years in crab trap/pot fisheries have been documented. 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). The crab trap/pot fisheries operating within this stock's boundaries have no observer coverage. Therefore, any 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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