COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*) Northern South Carolina 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, to 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. Photo-identification (photo-ID) studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; Sloan 2006; Rosel *et al.* 2009; Litz *et al.* 2012), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Sellas *et al.* 2005; Balmer *et al.* 2008; Rosel *et al.* 2017).

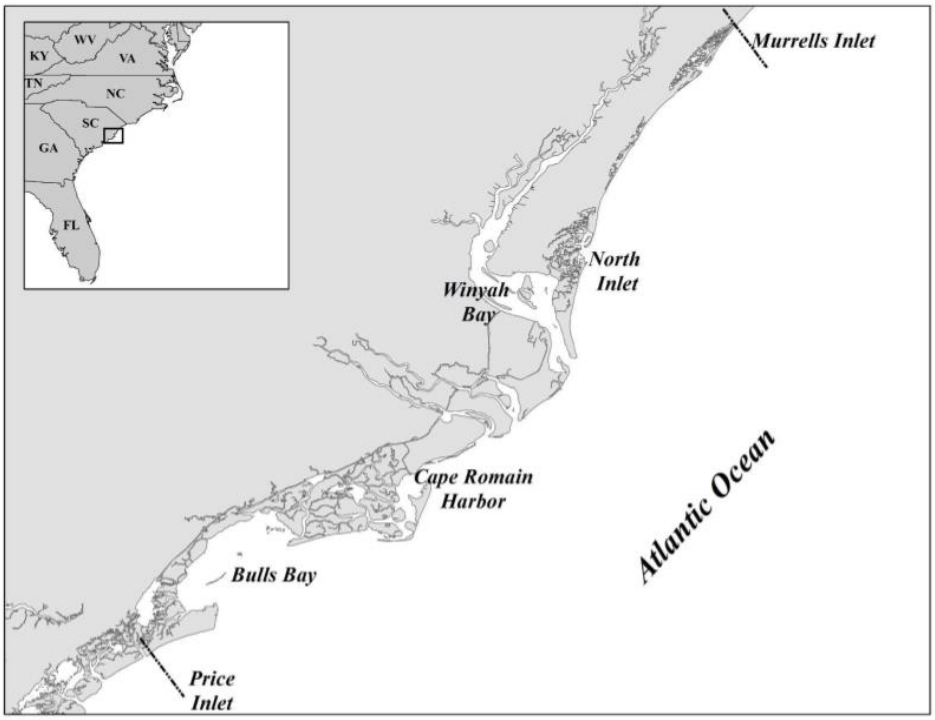

Figure 1. ***Geographic extent of the Northern South Carolina Estuarine System (NSCES) Stock. Dashed lines denote the boundaries.***

Estuarine waters of central South Carolina are characterized by tidal salt marsh around Bulls Bay and the Cape Romain National Wildlife Refuge, and inlets leading to smaller marsh systems, such as at Murrells Inlet. This region has minimal industrial development. Much of the habitat is a shallow, meso-tidal (2–4 m tidal range) estuary consisting of deep channels, creeks, bays and inlets with tidal mud flats and oyster reefs navigable only at high tide (Petricig 1995; Dame *et al.* 2000; Young and Phillips 2002; Sloan 2006).

Sloan (2006) analyzed photo-ID data collected during April–September 2002, July–August 2003 and September 2003 through August 2005 in the Cape Romain National Wildlife Refuge. In total, 1,900 common bottlenose dolphins were recorded during 445 sightings, with 121 individuals identified. Only 36% of individuals had dorsal fins that were considered identifiable. Of the 121 individuals, twenty-two (18%) year-round residents (sighted 4–20 times and in all four water temperature classes: <13°C (cool), 13–19°C (cool transitional), 20–27°C (warm transitional) and >27°C (warm)), 49 (40%) seasonal residents (sighted in 1–3 temperature classes over multiple years or three temperature classes in the same year), and 50 (41%) transients were identified. Sloan (2006) noted that three of the 49 seasonal residents were sighted 10–19 times each, and may be residents missed during months with less survey effort. All year-round residents were sighted exclusively within the salt marsh and never in the coastal waters. Twelve year-round residents showed long-term site-fidelity, with 10 individuals sighted over three years and two individuals sighted over four years. Seasonal shifts in abundance were seen and were attributed to shifts in abundance and behavior of prey species (Sloan 2006).

More recently, Brusa *et al.* (2016) conducted photo-ID surveys in Winyah Bay and North Inlet, South Carolina,

to examine distribution and home ranges of common bottlenose dolphins. During May 2011–February 2012, Brusa *et al.* (2016) identified 84 dolphins sighted three or more times on non-consecutive days, with 71 of those sighted during the warm season (May–October), two during the cold season (December–February), and 11 during warm and cold seasons. Similar to Cape Romain, dolphins were present in warm and cold seasons, but found to be less abundant during the cold season. During the warm season, three dolphins were sighted in North Inlet only, 38 dolphins in Winyah Bay only, and 41 dolphins were sighted in both North Inlet and Winyah Bay.

Six dolphins identified in the Cape Romain area were matched via the mid-Atlantic Bottlenose Dolphin Catalog (Urian *et al.* 1999) to animals seen in estuarine waters of Winyah Bay and/or North Inlet, one of which had an extensive year-round sighting history in these northern estuarine waters (Sloan 2006). One dolphin seen in the Cape Romain area was also sighted in Murrells Inlet, South Carolina, north of North Inlet (Sloan 2006). However, this animal was sighted only once and so it is difficult to know whether it was an estuarine animal or simply a coastal dolphin that explored these two areas.

Given the results of these photo-ID studies, the Northern South Carolina Estuarine System (NSCES) Stock is delimited as dolphins inhabiting estuarine waters from Murrells Inlet, South Carolina, southwest to Price Inlet, South Carolina, the northern boundary of the Charleston Estuarine System Stock (Figure 1). Dolphins may be present as far inland as the Intracoastal Waterway and the stock boundary also includes coastal waters up to 1 km offshore. Murrells Inlet is a small estuarine area and likely does not support its own stock of common bottlenose dolphins, but could be utilized by estuarine dolphins from further south. As a result, the stock boundaries for the NSCES Stock include the North Inlet estuary north to Murrells Inlet. North of Murrells Inlet, South Carolina, there is a long stretch of sandy beach with few inlets and no significant estuarine waters. However, these boundaries are subject to change upon further study of dolphin residency patterns in estuarine waters of South Carolina. There are insufficient data to determine whether multiple demographically-independent stocks exist within the NSCES area as there have been no directed studies to address this question.

POPULATION SIZE

The best available abundance estimate for the NSCES Stock of common bottlenose dolphins is 453 (95% CI:265–773; CV=0.28; Table 1), based on an August–October 2016 vessel-based capture-recapture photo-ID survey (Silva *et al.* 2019).

Recent surveys and abundance estimates

Silva *et al.* (2019) conducted vessel-based capture-recapture photo-ID surveys during 11 August to 2 October 2016 to estimate abundance of common bottlenose dolphins of the NSCES Stock. One “mark” and two “recapture” sessions were conducted encompassing 245 km of trackline within small bays, salt marsh creeks, and portions of the Intracoastal Waterway. Coastal waters were not surveyed. Surveys extended from North Inlet/Winyah Bay to Dewees Inlet but abundance was estimated only within the current stock boundary to Price Inlet. Data were analyzed with the package Rcapture in Program R, and the bias corrected Chao Mth model was the best fit. Abundance of marked individuals within the stock area was estimated to be 163 dolphins (95% CI:110–282), and this estimate was divided by the proportion of marked individuals (0.36) to estimate total abundance. Therefore, the best estimate for the NSCES Stock was 453 (95% CI:265–773; CV=0.28; Table 1).

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). The best estimate for the NSCES Stock is 453 (CV=0.28). The resulting minimum population estimate is 359 (Table 1).

Current Population Trend

There are insufficient data to determine the population trends for this stock because only one estimate of population size is available for the entire stock area.

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 NSCES Stock is 359. 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. PBR for this stock of common bottlenose dolphins is 3.6 (Table 1).

Table 1. Best and minimum abundance estimates (Nest and Nmin) for the NSCES Stock of common bottlenose dolphins with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

Nest	CV Nest	Nmin	Fr	Rmax	PBR
453	0.28	359	0.5	0.04	3.6

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the NSCES Stock during 2016–2020 is unknown. The mean annual fishery-related mortality and serious injury during 2016–2020 based on strandings and at-sea observations identified as fishery-related was 0.3. Additional mean annual mortality and serious injury during 2016–2020 due to other human-caused sources was 0.2 (vessel strike by a research vessel). The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 0.5 (Table 2). This is considered a minimum because 1) not all fisheries that could interact with this stock are observed and/or observer coverage is very low, 2) stranding data are used as an indicator of fishery-related interactions and not all dead animals are recovered by the stranding network (Peltier *et al.* 2012; Wells *et al.* 2015; Carretta *et al.* 2016), 3) cause of death is not (or cannot be) routinely determined for stranded carcasses, and 4) the estimate of fishery-related interactions includes an actual count of verified fishery-caused deaths and serious injuries and should be considered a minimum (NMFS 2016).

Fishery Information

There are two commercial fisheries that interact, or that potentially could interact, with this stock. These include the Category II Southeast Atlantic inshore gillnet fishery and the Atlantic blue crab trap/pot fishery. Detailed fishery information is presented in Appendix III.

Note: Animals reported in the sections to follow were ascribed to a stock or stocks of origin following methods described in Maze-Foley et al. (2019). These include strandings, observed takes (through an observer program), fisherman self-reported takes (through the Marine Mammal Authorization Program), research takes, and opportunistic at-sea observations.

Gillnet

During 2016–2020, there were no documented mortalities or serious injuries of common bottlenose dolphins involving gillnet gear. The most recent documented interaction with this fishery was a mortality that occurred in 2011. It should be noted that there is no observer program for this fishery, so it is not possible to estimate the total number of interactions or mortalities associated with gillnets.

Trap/Pot

During 2016–2020 there were two documented entanglement interactions of common bottlenose dolphins in the NSCES Stock area with commercial blue crab trap/pot gear. During 2016 there was one live animal disentangled from commercial blue crab trap/pot gear and released alive, and it was considered seriously injured post-mitigation (Maze-Foley and Garrison 2022). During 2018 there was another live animal entangled in commercial blue crab trap/pot gear, and it could not be determined (CBD) whether the animal was seriously injured following mitigation efforts (the initial determination was seriously injured; Maze-Foley and Garrison 2022). The serious injury and CBD for serious injury (the CBD case was prorated based on previous assignable injury events; NMFS 2012; Maze-Foley and Garrison 2022) are included in the annual human-caused mortality and serious injury total for this stock (Table 2), and were also documented within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021). Since there is no observer program, it is not possible to estimate the total number of interactions or mortalities associated with these crab trap/pot fisheries. The documented interactions in this gear represent a minimum known count of interactions in the last five years.

Other Mortality

There was one additional documented serious injury for this stock. In 2017 a common bottlenose dolphin was struck by a research vessel and was considered seriously injured (Maze-Foley and Garrison 2022). All mortalities and serious injuries from known sources for the NSCES Stock are summarized in Table 2.

Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (*Tursiops truncatus*) of the Northern South Carolina Estuarine System Stock. The fisheries do not have an ongoing, federal observer program, so counts of mortality and serious injury were based on stranding data, at-sea observations, or fisherman self-reported takes via the Marine Mammal Authorization Program (MMAP). For strandings, at-sea counts, and fisherman self-reported takes, the number reported is a minimum because not all strandings, at-sea cases, or gear interactions are detected. See the Annual Human-Caused Mortality and Serious Injury section for biases and limitations of mortality estimates, and the Strandings section for limitations of stranding data. NA = not applicable. *Indicates the count would have been higher had it not been for mitigation efforts (see text for that specific fishery for further details).

Fishery	Years	Data Type	Mean Annual Estimated Mortality and Serious Injury Based on Observer Data	5-year Minimum Count Based on Stranding, At-Sea, and/or MMAP Data
Gillnet	2016–2020	Stranding Data and At-Sea Observations	NA	0
Commercial Blue Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	1.5*[a]
Mean Annual Mortality due to commercial fisheries (2016–2020)			**0.3**	
Mean Annual Mortality due to other takes (2016–2020) (vessel strike by a research vessel)			**0.2**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)			**0.5**	

a. Includes one non-calf entanglement in which the post-mitigation determination was CBD. The CBD was prorated as 0.46 (rounded to 0.5) serious injuries based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison 2022).

Strandings

During 2016–2020 seven common bottlenose dolphins were reported stranded within the NSCES Stock area (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021). There was evidence of human interaction for two of the strandings. No evidence of human interaction was detected for three strandings, and for the remaining two strandings, it could not be determined if there was evidence of human interaction. Human interactions were from entanglements with commercial blue crab trap/pot gear as described above, and there was also a self-reported vessel strike by a research vessel for one animal. It should be noted that evidence of human interaction does not necessarily mean the interaction caused the animal's stranding or death. However, for any case for which it could be determined that a human interaction contributed to an animal's stranding, serious injury, or death, the case was included in the counts of mortality and serious injury in Table 2.

Stranding data 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; Carretta *et al.* 2016). 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.

The NSCES Stock has been affected by two unusual mortality events (UMEs) during the past 15 years. A UME was declared in South Carolina during February–May 2011. One stranding assigned to the NSCES Stock was considered to be part of the UME. The cause of this UME was undetermined. An additional UME occurred during 2013–2015 along the Atlantic coast of the U.S. and was attributed to morbillivirus (Morris *et al.* 2015). The total number of stranded common bottlenose dolphins from New York through North Florida (Brevard County) during the 2013–2015 UME was 1,614 (https://www.fisheries.noaa.gov/national/marine-life-distress/2013-2015-bottlenose-dolphin-unusual-mortality-event-mid-atlantic, accessed 13 November 2019). Most strandings and morbillivirus positive animals were recovered from the ocean side beaches rather than from within the estuaries, suggesting that coastal stocks may have been more impacted by this UME than estuarine stocks (Morris *et al.* 2015).

Table 3. Common bottlenose dolphin strandings occurring in the Northern South Carolina Estuarine System Stock area from 2016 to 2020, including the number of strandings for which evidence of human interaction (HI) was detected and number of strandings for which it could not be determined (CBD) if there was evidence of HI. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 15 June 2021). Please note HI does not necessarily mean the interaction caused the animal's death.

Stock	Category	2016	2017	2018	2019	2020	Total
Northern South Carolina Estuarine System Stock	Total Stranded	2	2	3	0	0	7
	HI--Yes	1a	0	1b	0	0	2
	HI--No	1	2	0	0	0	3
	HI--CBD	0	0	2	0	0	2

a. Includes 1 fishery interaction (FI), an entanglement interaction with commercial blue crab trap/pot gear (released alive seriously injured)

b. Includes 1 FI, an entanglement interaction with commercial blue crab trap/pot gear (released alive, CBD if seriously injured)

STATUS OF STOCK

Common bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act, and this stock is not a strategic stock under the MMPA. The documented mean annual human-caused mortality for the NSCES stock for 2016–2020 was 0.5. However, it is likely the estimate of annual human-caused, including fishery-caused, mortality and serious injury is biased low as indicated above (see Annual Human-Caused Mortality and Serious Injury section). Wells *et al.* (2015) estimated that the proportion of common bottlenose dolphin carcasses recovered in Sarasota Bay, a relatively open and urbanized estuarine environment, was 0.33, indicating significantly more mortalities occur than are recovered. For a less developed area consisting of a more complex salt marsh habitat, the Barataria Bay Estuarine System, the estimated proportion of common bottlenose dolphin carcasses recovered was 0.16 (DWH MMIQT 2015). The Barataria Bay recovery rate may be most appropriate for this stock given that much of the habitat consists of tidal salt marshes. When annual human-caused mortality and serious injury is corrected for unrecovered carcasses using the 0.16 recovery rate (n=3.1), it does not exceed the PBR for this stock based on a minimum abundance of 359. Total fishery-related mortality and serious injury for this stock is unknown, but at a minimum is greater than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of this stock relative to optimum sustainable population is unknown. There are insufficient data to determine population trends for this stock.

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