Table of Contents

TABLE 1. A SUMMARY OF ATLANTIC MARINE MAMMAL STOCK ASSESSMENT REPORTS FOR STOCKS OF MARINE MAMMALS UNDER NMFS AUTHORITY THAT OCCUPY WATERS UNDER USA JURISDICTION.

Total annual mortality serious injury (M/SI) and annual fisheries M/SI are mean annual figures for the period ~~2015~~2016–~~2019~~2020. Nest = estimated abundance, CV = coefficient of variation, Nmin = minimum abundance estimate, Rmax = maximum productivity rate, Fr = recovery factor, PBR = potential biological removal, unk = unknown, and undet = undetermined (PBR for species with outdated abundance estimates is considered "undetermined").

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
1	North Atlantic right whale	Western North Atlantic	Y	~~368~~338	0	~~364~~332	0.04	0.1	0.7	~~7.7~~8.1	5.7	Y	~~2020~~2021	~~2019~~2020		NEC
2	Humpback whale	Gulf of Maine	N	1,396	0	1,380	0.065	0.5	22	12.15	7.75	N	2019	2016		NEC
3	Fin whale	Western North Atlantic	~~Y~~N	6,802	0.24	5,573	0.04	0.1	11	1.8	1.4	Y	~~2020~~2021	2016		NEC
4	Sei whale	Nova Scotia	~~Y~~N	6,292	1.02	3,098	0.04	0.1	6.2	0.8	0.4	Y	~~2020~~2021	2016		NEC
5	Minke whale	Canadian East Coast	~~Y~~N	21,968	0.31	17,002	0.04	0.5	170	10.6	9.65	N	~~2020~~2021	2016		NEC
6	Blue whale	Western North Atlantic	N	unk	unk	402	0.04	0.1	0.8	0	0	Y	2019	1980–2008		NEC
7	Sperm whale	North Atlantic	N	4,349	0.28	3,451	0.04	0.1	3.9	0	0	Y	2019	2016		NEC
8	Dwarf sperm whale	Western North Atlantic	N	7,750	0.38	5,689	0.04	0.4	46	0	0	N	2019	2016	Estimate for *Kogia spp.* Only.	SEC
9	Pygmy sperm whale	Western North Atlantic	N	7,750	0.38	5,689	0.04	0.4	46	0	0	N	2019	2016	Estimate for *Kogia spp.* Only.	SEC
10	Killer whale	Western North Atlantic	N	unk	unk	unk	0.04	0.5	unk	0	0	N	2014	2016		NEC
11	Pygmy killer whale	Western North Atlantic	N	unk	unk	unk	0.04	0.5	unk	0	0	N	2019	2016		SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
12	False killer whale	Western North Atlantic	N	1,791	0.56	1,154	0.04	0.5	12	0	0	N	2019	2016		SEC
13	Northern bottlenose whale	Western North Atlantic	N	unk	unk	unk	0.04	0.5	unk	0	0	N	2014	2016		NEC
14	Cuvier's beaked whale	Western North Atlantic	N	5,744	0.36	4,282	0.04	0.5	43	0.2	0	N	2019	2016		NEC
15	Blainville's beaked whale	Western North Atlantic	N	10,107	0.27	8,085	0.04	0.5	81	0.2	0	N	2019	2016	Estimates for *Mesoplodon spp.*	NEC
16	Gervais beaked whale	Western North Atlantic	N	10,107	0.27	8,085	0.04	0.5	81	0	0	N	2019	2016	Estimates for *Mesoplodon spp.*	NEC
17	Sowerby's beaked whale	Western North Atlantic	N	10,107	0.27	8,085	0.04	0.5	81	0	0	N	2019	2016	Estimates for *Mesoplodon spp.*	NEC
18	True's beaked whale	Western North Atlantic	N	10,107	0.27	8,085	0.04	0.5	81	0.2	0.2	N	2019	2016	Estimates for *Mesoplodon spp.*	NEC
19	Melon-headed whale	Western North Atlantic	N	unk	unk	unk	0.04	0.5	unk	0	0	N	2019	2016		SEC
20	Risso's dolphin	Western North Atlantic	~~Y~~N	35,215	0.19	30,051	0.04	0.5	301	34	34 (0.09)	N	~~2019~~2021	2016		NEC
21	Pilot whale, long-finned	Western North Atlantic	~~Y~~N	39,215	0.30	30,627	0.04	0.5	306	9	9 (0.4)	N	~~2019~~2021	2016		NEC
22	Pilot whale, short-finned	Western North Atlantic	~~Y~~N	28,924	0.24	23,637	0.04	0.5	236	136	136 (0.14)	N	~~2019~~2021	2016		SEC
23	Atlantic white-sided dolphin	Western North Atlantic	~~Y~~N	93,233	0.71	54,443	0.04	0.5	544	27	27 (0.21)	N	~~2020~~2021	2016		NEC
24	White-beaked dolphin	Western North Atlantic	N	536,016	0.31	415,344	0.04	0.5	4,153	0	0	N	2019	2016		NEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
25	Common dolphin	Western North Atlantic	~~Y~~N	172,974	0.21	145,216	0.04	0.5	1,452	390	390 (0.11)	N	~~2020~~2021	2016		NEC
26	Atlantic spotted dolphin	Western North Atlantic	N	39,921	0.27	32,032	0.04	0.5	320	0	0	N	2019	2016		SEC
27	Pantropical spotted dolphin	Western North Atlantic	N	6,593	0.52	4,367	0.04	0.5	44	0	0	N	2019	2016		SEC
28	Striped dolphin	Western North Atlantic	N	67,036	0.29	52,939	0.04	0.5	529	0	0	N	2019	2016		NEC
29	Fraser's dolphin	Western North Atlantic	N	unk	unk	unk	0.04	0.5	unk	0	0	N	2019	2016		SEC
30	Rough-toothed dolphin	Western North Atlantic	N	136	1.0	67	0.04	0.5	0.7	0	0	N	2018	2016		SEC
31	Clymene dolphin	Western North Atlantic	N	4,237	1.03	2,071	0.04	0.5	21	0	0	N	2019	2016		SEC
32	Spinner dolphin	Western North Atlantic	N	4,102	0.99	2,045	0.04	0.5	20	0	0	N	2019	2016		SEC
33	Common bottlenose dolphin	Western North Atlantic, Offshore	N	62,851	0.23	51,914	0.04	0.5	519	28	28 (0.34)	N	2019	2016	Estimates may include sightings of the coastal form.	SEC
34	Common bottlenose dolphin	Western North Atlantic, Northern Migratory Coastal	N	6,639	0.41	4,759	0.04	0.5	48	12.2–21.5	12.2–21.5	Y	2020	2016		SEC
35	Common bottlenose dolphin	Western North Atlantic, Southern Migratory Coastal	N	3,751	0.60	2,353	0.04	0.5	24	0–18.3	0–18.3	Y	2020	2016		SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
36	Common bottlenose dolphin	Western North Atlantic, S. Carolina, Georgia Coastal	N	6,027	0.34	4,569	0.04	0.5	46	1.4–1.6	1.0–1.2	Y	2017	2017		SEC
37	Common bottlenose dolphin	Western North Atlantic, Northern Florida Coastal	N	877	0.49	595	0.04	0.5	6.0	0.6	0	Y	2017	2017		SEC
38	Common bottlenose dolphin	Western North Atlantic, Central Florida Coastal	N	1,218	0.35	913	0.04	0.5	9.1	0.4	0.4	Y	2017	2017		SEC
39	Common bottlenose dolphin	Northern North Carolina Estuarine System	N	823	0.06	782	0.04	0.5	7.8	7.2–30	7.0–29.8	Y	2020	2017		SEC
40	Common bottlenose dolphin	Southern North Carolina Estuarine System	N	unk	unk	unk	0.04	0.5	undet	0.4	0.4	Y	2020	2017		SEC
41	Common bottlenose dolphin	Northern South Carolina Estuarine System	~~N~~Y	~~unk~~453	~~unk~~0.28	~~unk~~359	0.04	0.5	~~unk~~3.6	0.5~~2~~	0.3~~2~~	~~Y~~N	2015	~~n/a~~2016		SEC
42	Common bottlenose dolphin	Charleston Estuarine System	~~N~~Y	unk	unk	unk	0.04	0.5	undet	~~unk~~2.2	~~unk~~1.8	Y	2015	2005, 2006		SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
43	Common bottlenose dolphin	Northern Georgia, Southern South Carolina Estuarine System	~~N~~Y	unk	unk	unk	0.04	0.5	unk	1.5~~4~~	1.3~~4~~	Y	2015	n/a		SEC
44	Common bottlenose dolphin	Central Georgia Estuarine System	~~N~~Y	~~192~~unk	~~0.04~~unk	~~185~~unk	0.04	0.5	~~1.9~~undet	~~unk~~0.4	~~unk~~0.2	~~Y~~N	2015	2008, 2009		SEC
45	Common bottlenose dolphin	Southern Georgia Estuarine System	~~N~~Y	~~194~~unk	~~0.05~~unk	~~185~~unk	0.04	0.5	~~1.9~~undet	~~unk~~0.1	~~unk~~0.1	~~Y~~N	2015	2008, 2009		SEC
46	Common bottlenose dolphin	Jacksonville Estuarine System	~~N~~Y	unk	unk	unk	0.04	0.5	unk	~~1.2~~2.0	~~1.2~~2.0	Y	2015	n/a		SEC
47	Common bottlenose dolphin	Indian River Lagoon Estuarine System	~~N~~Y	~~unk~~1,032	~~unk~~0.03	~~unk~~1,004	0.04	0.5	~~unk~~10	~~4.4~~5.7	~~4.4~~3.0	Y	2015	~~n/a~~2016, 2017		SEC
48	Common bottlenose dolphin	Biscayne Bay	~~N~~Y	unk	unk	unk	0.04	0.5	unk	~~unk~~0.8	~~unk~~0.6	~~Y~~N	2013	n/a		SEC
~~49~~	~~Common bottlenose dolphin~~	~~Florida Bay~~	~~N~~	~~unk~~	~~unk~~	~~unk~~	~~0.04~~	~~0.5~~	~~undet~~	~~unk~~	~~unk~~	~~N~~	~~2013~~	~~2003~~		~~SEC~~
~~50~~49	Harbor porpoise	Gulf of Maine, Bay of Fundy	~~Y~~N	95,543	0.31	74,034	0.046	0.5	851	164	163 (0.13)	N	~~2020~~2021	2016		NEC
50~~1~~	Harbor seal	Western North Atlantic	~~Y~~N	61,336	0.08	57,637	0.12	0.5	1,729	339	334 (0.09)	N	~~2020~~2021	2018		NEC
51~~2~~	Gray seal	Western North Atlantic	~~Y~~N	27,300	0.22	22,785	0.128	1.0	1,458	4,453	1,169 (0.10)	N	~~2020~~2021	2016		NEC
52~~3~~	Harp seal	Western North Atlantic	~~Y~~N	7.6M	unk	7.1M	0.12	1.0	426,000	178,573	86 (0.16)	N	~~2019~~2021	2019		NEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
53~~4~~	Hooded seal	Western North Atlantic	N	unk	unk	unk	0.12	0.75	unk	1,680	0.6 (1.12)	N	2018	n/a		NEC
54~~5~~	Sperm whale	Gulf of Mexico	N	1,180	0.22	983	0.04	0.1	2.0	9.6	0.2 (1.0)	Y	2020	2017, 2018		SEC
55~~6~~	~~Bryde~~Rice's whale	Gulf of Mexico	~~N~~Y	51	0.5	34	0.04	0.1	0.1	0.5	0	Y	2020	2017, 2018	Total M/SI is a minimum estimate and does not include Fisheries M/SI.	SEC
56~~7~~	Cuvier's beaked whale	Gulf of Mexico	N	18	0.75	10	0.04	0.5	0.1	5.2	0	N	2020	2017, 2018		SEC
57~~8~~	Blainville's beaked whale	Gulf of Mexico	N	98	0.46	68	0.04	0.5	0.7	5.2	0	N	2020	2017, 2018	Estimates for *Mesoplodon spp.*	SEC
58~~9~~	Gervais' beaked whale	Gulf of Mexico	N	20	0.98	10	0.04	0.5	0.1	5.2	0	N	2020	2017, 2018		SEC
~~60~~59	Common bottlenose dolphin	Gulf of Mexico, Continental Shelf	~~Y~~N	63,280	0.11	57,917	0.04	0.48	556	65	64.6	N	~~2015~~2021	2017, 2018	M/S is a minimum count and does not include projected mortality estimates for 2015–2019 due to the DWH oil spill.	SEC
60~~1~~	Common bottlenose dolphin	Gulf of Mexico, Eastern Coastal	~~Y~~N	16,407	0.17	14,199	0.04	0.4	114	9.2	8.8	N	~~2015~~2021	2017, 2018		SEC
61~~2~~	Common bottlenose dolphin	Gulf of Mexico, Northern Coastal	~~Y~~N	11,543	0.19	9,881	0.04	0.45	89	28	7.9	N	~~2015~~2021	2017, 2018		SEC
62~~3~~	Common bottlenose dolphin	Gulf of Mexico, Western Coastal	~~Y~~N	20,759	0.13	18,585	0.04	0.45	167	36	32.4	N	~~2015~~2021	2017, 2018		SEC
63~~4~~	Common bottlenose dolphin	Gulf of Mexico, Oceanic	N	7,462	0.31	5,769	0.04	0.5	58	32	0	N	2020	2017, 2018		SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
64~~5~~	Common bottlenose dolphin	Laguna Madre	~~Y~~N	80	1.57	unk	0.04	0.4	undet	0.8	0.2	Y	~~2018~~2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
65~~6~~	Common bottlenose dolphin	Neuces Bay, Corpus Christi Bay	~~Y~~N	58	0.61	unk	0.04	0.4	undet	0.2	0	Y	~~2018~~2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
66~~7~~	Common bottlenose dolphin	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay	~~Y~~N	55	0.82	unk	0.04	0.4	undet	0.6	0	Y	~~2018~~2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
67~~8~~	Common bottlenose dolphin	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	~~Y~~N	61	0.45	unk	0.04	0.4	undet	0.4	0	Y	~~2018~~2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
68~~9~~	Common bottlenose dolphin	West Bay	~~Y~~N	37	0.05	35	0.04	0.4	0.3	0	0	N	~~2019~~2021	2014, 2015		SEC
~~70~~69	Common bottlenose dolphin	Galveston Bay, East Bay, Trinity Bay	~~Y~~N	842	0.08	787	0.04	0.4	6.3	1.0	0.4	N	~~2018~~2021	2016		SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
70~~1~~	Common bottlenose dolphin	Sabine Lake	~~Y~~N	122	0.19	104	0.04	0.45	0.9	0	0	N	~~2018~~2021	2017	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
71~~2~~	Common bottlenose dolphin	Calcasieu Lake	~~Y~~N	0	-	-	0.04	0.45	undet	0.2	0.2	Y	~~2018~~2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
72~~3~~	Common bottlenose dolphin	Vermilion Bay, West Cote Blanche Bay, Atchafalaya Bay	~~Y~~N	0	-	-	0.04	0.45	undet	0	0	Y	~~2018~~2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
73~~4~~	Common bottlenose dolphin	Terrebonne, Timbalier Bay Estuarine System	N	3,870	0.15	3,426	0.04	0.4	27	0.2	0	N	2018	2016		SEC
74~~5~~	Common bottlenose dolphin	Barataria Bay Estuarine System	~~Y~~N	2,071	0.06	1,971	0.04	0.45	18	41	0	Y	~~2017~~2021	2019		SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
75~~6~~	Common bottlenose dolphin	Mississippi River Delta	~~Y~~N	1,446	0.19	1,238	0.04	0.4	11	9.2	0.2	N	~~2018~~2021	2017–2018	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
76~~7~~	Common bottlenose dolphin	Mississippi Sound, Lake Borgne, Bay Boudreau	~~Y~~N	1,265	0.35	947	0.04	0.45	8.5	59	2.0	Y	~~2017~~2021	2018		SEC
77~~8~~	Common bottlenose dolphin	Mobile Bay, Bonsecour Bay	~~Y~~N	122	0.34	unk	0.04	0.45	undet	16.0	1.0	Y	~~2018~~2021	1993	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
78~~9~~	Common bottlenose dolphin	Perdido Bay	~~Y~~N	0	-	-	0.04	0.4	undet	0.8	0.6	Y	~~2018~~2021	1993	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
~~80~~79	Common bottlenose dolphin	Pensacola Bay, East Bay	~~Y~~N	33	0.80	unk	0.04	0.4	undet	0.4	0.2	Y	~~2018~~2021	1993	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
80~~1~~	Common bottlenose dolphin	Choctawhatchee Bay	N	179	0.04	unk	0.04	0.5	undet	0.4	0	Y	2015	2007		SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
81~~2~~	Common bottlenose dolphin	St. Andrew Bay	N	199	0.09	185	0.04	0.4	1.5	0.2	0.2	N	2019	2016		SEC
82~~3~~	Common bottlenose dolphin	St. Joseph Bay	N	142	0.17	123	0.04	0.4	1.0	unk	unk	N	2019	2011		SEC
83~~4~~	Common bottlenose dolphin	St. Vincent Sound, Apalachicola Bay, St. George Sound	~~Y~~N	439	0.14	unk	0.04	0.4	undet	0.2	0.2	Y	~~2018~~2021	2007	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
84~~5~~	Common bottlenose dolphin	Apalachee Bay	~~Y~~N	491	0.39	unk	0.04	0.4	undet	0	0	Y	~~2018~~2021	1993	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
85~~6~~	Common bottlenose dolphin	Waccasassa Bay, Withla-coochee Bay, Crystal Bay	~~Y~~N	unk	-	unk	0.04	0.4	undet	0.4	0.4	Y	~~2018~~2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
86~~7~~	Common bottlenose dolphin	St. Joseph Sound, Clearwater Harbor	~~Y~~N	unk	-	unk	0.04	0.4	undet	0.8	0.4	Y	~~2018~~2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
87~~8~~	Common bottlenose dolphin	Tampa Bay	~~Y~~N	unk	-	unk	0.04	0.4	undet	3.0	2.2	Y	~~2018~~2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
88~~9~~	Common bottlenose dolphin	Sarasota Bay, Little Sarasota Bay	~~Y~~N	158	0.27	126	0.04	0.4	1.0	0.2	0.2	N	~~2018~~2021	2015	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
~~90~~89	Common bottlenose dolphin	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay	~~Y~~N	826	0.09	unk	0.04	0.4	undet	1.0	0.6	Y	~~2018~~2021	2006	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
90~~1~~	Common bottlenose dolphin	Caloosa-hatchee River	~~Y~~N	0	-	-	0.04	0.4	undet	0.4	0.2	Y	~~2018~~2021	1985	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
91~~2~~	Common bottlenose dolphin	Estero Bay	~~Y~~N	unk	-	unk	0.04	0.4	undet	0.4	0.2	Y	~~2018~~2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
92~~3~~	Common bottlenose dolphin	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	~~Y~~N	unk	-	unk	0.04	0.4	undet	0.2	0.2	Y	~~2018~~2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
93~~4~~	Common bottlenose dolphin	Whitewater Bay	~~Y~~N	unk	-	unk	0.04	0.4	undet	0	0	Y	~~2018~~2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
94	Common bottlenose dolphin	Florida Bay	Y	unk	unk	unk	0.04	0.5	unk	0.2	0.2	N	2013	2003		SEC
95	Common bottlenose dolphin	Florida Keys (Bahia Honda to Key West)	~~Y~~N	unk	-	unk	0.04	0.4	undet	0.2	0.2	Y	~~2018~~2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of Mexico Bay, Sound, and Estuary Stocks.	SEC
96	Atlantic spotted dolphin	Gulf of Mexico	~~Y~~N	21,506	0.26	17,339	0.04	0.48	166	36	36 (0.47)	N	~~2015~~2021	2017, 2018	M/S is a minimum count and does not include projected mortality estimates for 2015–2019 due to the DWH oil spill.	SEC
97	Pantropical spotted dolphin	Gulf of Mexico	N	37,195	0.24	30,377	0.04	0.5	304	241	0	N	2020	2017, 2018		SEC
98	Striped dolphin	Gulf of Mexico	N	1,817	0.56	1,172	0.04	0.5	12	13	0	Y	2020	2017, 2018		SEC
99	Spinner dolphin	Gulf of Mexico	N	2,991	0.54	1,954	0.04	0.5	20	113	0	Y	2020	2017, 2018		SEC
100	Rough-toothed dolphin	Gulf of Mexico	N	unk	n/a	unk	0.04	0.4	undet	39	0.8 (1.00)	N	2020	2017, 2018		SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
101	Clymene dolphin	Gulf of Mexico	N	513	1.03	250	0.04	0.5	2.5	8.4	0	Y	2020	2017, 2018		SEC
102	Fraser's dolphin	Gulf of Mexico	N	213	1.03	104	0.04	0.5	1.0	unk	0	N	2020	2017, 2018		SEC
103	Killer whale	Gulf of Mexico	N	267	0.75	152	0.04	0.5	1.5	unk	0	N	2020	2017, 2018		SEC
104	False killer whale	Gulf of Mexico	N	494	0.79	276	0.04	0.5	2.8	2.2	0	N	2020	2017, 2018		SEC
105	Pygmy killer whale	Gulf of Mexico	N	613	1.15	283	0.04	0.5	2.8	1.6	0	N	2020	2017, 2018		SEC
106	Dwarf sperm whale	Gulf of Mexico	N	336	0.35	253	0.04	0.5	2.5	31	0	N	2020	2017, 2018	Estimate for *Kogia spp.* only.	SEC
107	Pygmy sperm whale	Gulf of Mexico	N	336	0.35	253	0.04	0.5	2.5	31	0	N	2020	2017, 2018	Estimate for *Kogia spp.* only.	SEC
108	Melon-headed whale	Gulf of Mexico	N	1,749	0.68	1,039	0.04	0.5	10	9.5	0	N	2020	2017, 2018		SEC
109	Risso's dolphin	Gulf of Mexico	N	1,974	0.46	1,368	0.04	0.5	14	5.3	0	N	2020	2017, 2018		SEC
110	Pilot whale, short-finned	Gulf of Mexico	N	1,321	0.43	934	0.04	0.4	7.5	3.9	0.4 (1.00)	N	2020	2017, 2018	Nbest includes all *Globicephala sp.*, though it is presumed that only short-finned pilot whales are present in the Gulf of Mexico.	SEC
111	Sperm Whale	Puerto Rico and U.S. Virgin Islands	N	unk	unk	unk	0.04	0.1	unk	unk	unk	Y	2010	n/a		SEC
112	Common bottlenose dolphin	Puerto Rico and U.S. Virgin Islands	N	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	2011	n/a		SEC
113	Cuvier's beaked whale	Puerto Rico and U.S. Virgin Islands	N	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	2011	n/a		SEC

ID	Species	Stock Area	Updated this Year	Nest	Nest CV	Nmin	Rmax	Fr	PBR	Total Annual M/SI	Annual Fish. M/SI (CV)	Strategic Status	SAR of Last Update	Last Survey Year	Comments	NMFS Ctr.
114	Pilot whale, short-finned	Puerto Rico and U.S. Virgin Islands	N	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	2011	n/a		SEC
115	Spinner dolphin	Puerto Rico and U.S. Virgin Islands	N	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	2011	n/a		SEC
116	Atlantic spotted dolphin	Puerto Rico and U.S. Virgin Islands	N	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	2011	n/a		SEC

NORTH ATLANTIC RIGHT WHALE (*Eubalaena glacialis*): Western Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The western North Atlantic right whale population ranges primarily from calving grounds in coastal waters of the southeastern U.S. to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (Figure 1). Mellinger *et al.* (2011) reported acoustic detections of right whales near the ~~nineteenth~~19th-century whaling grounds east of southern Greenland, but the number of whales and their origin is unknown. Knowlton *et al.* (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland. Resightings of photographically identified individuals have been made off Iceland, in the old Cape Farewell whaling ground east of Greenland (Hamilton *et al.* 2007), in northern Norway (Jacobsen *et al.* 2004), in the Azores (Silva *et al.* 2012), and off Brittany in northwestern France (New England Aquarium unpub. catalog record). These long-range matches indicate an extended range for at least some individuals. Records from the Gulf of Mexico (Moore and Clark 1963; Schmidly *et al.* 1972; Ward-Geiger *et al*. 2011; NMFS Southeast Regional Office unpublished data) represent individuals beyond the primary calving and wintering ground in the waters of the southeastern U.S. East Coast. ~~The location of much of the population is unknown during much of the year.~~

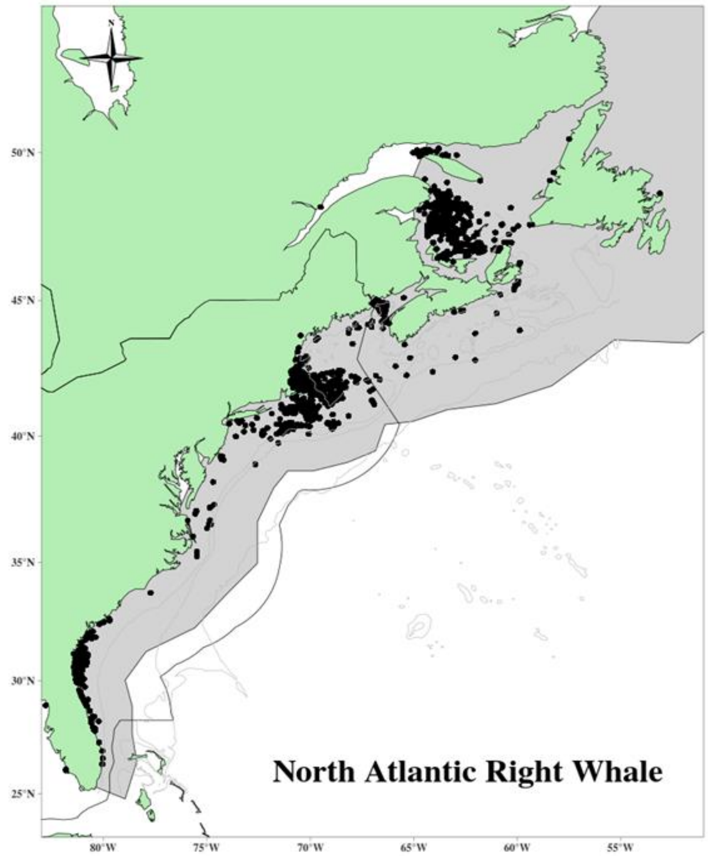


Figure 1. Approximate range (shaded area) and distribution of sightings (dots) of known North Atlantic right whales ~~2015–2019~~ 2016-2020.

Although the location of much of the population is unknown during much of the year, ~~P~~passive acoustic studies of right whales have demonstrated ~~their~~ year-round presence in the Gulf of Maine (Morano *et al*. 2012; Bort *et al*. 2015), New Jersey (Whitt *et al*. 2013), and Virginia (Salisbury *et al*. 2016). Additionally, right whales were acoustically detected off Georgia and North Carolina in 7 of 11 months monitored (Hodge *et al*. 2015). Davis *et al*. (2017) ~~recently~~ pooled together detections from a large number of passive acoustic devices and documented broad-scale use of the U.S. eastern seaboard during much of the year. In Canada, Simard *et al*. (2019) documented the frequency of right whale contact calls in the Gulf of St. Lawrence from June 2010 to November 2018 using a year-round passive acoustic network. Acoustic detections indicated right whale presence every year. The earliest seasonal detections were at the end of April, ~~and the latest detections in mid-January,~~ with peak detection frequency ~~occurrednce~~ between August and the end of October before decreasing with recurrent pulses until mid-January (Simard et al. 2019). Detections were focused in the southern Gulf, and daily detection rates quadrupled at listening stations off the Gaspé Peninsula beginning in 2015.

Individuals' movements within and between habitats across the range are extensive. In 2000, one whale was photographed in Florida waters on 12 January, then again 11 days later (23 January) in Cape Cod Bay, less than a month later off Georgia (16 February), and back in Cape Cod Bay on 23 March, effectively making the round-trip migration to the Southeast and back at least twice during the winter season (Brown and Marx 2000). Results from satellite-tagging studies clearly indicate that sightings separated by a few weeks in the same area should not necessarily be assumed to indicate a stationary or resident animal. Instead, telemetry data have shown lengthy excursions, including into deep water off the continental shelf, over short timeframes (Mate *et al*. 1997; Baumgartner and Mate 2005).

Systematic visual surveys conducted off the coast of North Carolina during the winters of 2001 and 2002 sighted 8 calves, suggesting the calving grounds may extend as far north as Cape Fear (W.A. McLellan, Univ. of North Carolina Wilmington, pers. comm.). Four of those calves were not sighted by surveys conducted farther south. One of the females photographed was new to researchers, having effectively eluded identification over the period of her~~its~~ maturation. In 2016, the Southeastern U.S. Calving Area Critical Habitat was expanded north to Cape Fear, North Carolina (81 FR 4837, 26 February 2016). There is also at least one case of a calf apparently being born in the Gulf of Maine (Patrician *et al*. 2009) and another neonate was detected in Cape Cod Bay in 2012 (Center for Coastal Studies, Provincetown, MA USA, unpub. data).

New England and Canadian waters are important feeding habitats for right whales, where they feed primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*). Right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitats (Kenney *et al*. 1986, 1995). The characteristics of acceptable prey distribution in these areas are summarized in Baumgartner *et al*. (2003)~~,~~ and Baumgartner and Mate (2003). In 2016, the Northeastern U.S. Foraging Area Critical Habitat was expanded to include nearly all U.S. waters of the Gulf of Maine (81 FR 4837, 26 February 2016).

Both visual and acoustic monitoring detected ~~A~~an important change in right whales' seasonal residency patterns beginning ~~shift in habitat- use patterns~~ in 2010, with reduced right whale presence in the Bay of Fundy and Gulf of Maine . ~~was highlighted in an analysis of right whale acoustic presence in the western North Atlantic from 2004 to 2014~~ (Davis *et al*. 2017; Davies et al. 2019)~~). This shift was also reflected in visual survey data in the greater Gulf of Maine region~~. Between 2012 and 2016, visual surveys ~~detected fewer individuals~~ in the Great South Channel also saw a sharp decline in right whale sightings (NMFS unpublished data)~~ and the Bay of Fundy (Davies *et al*. 2019)~~, while the number of individuals using Cape Cod Bay in spring increased (Mayo *et al*. 2018; Ganley *et al*. 2019). Right whale aggregations in~~In addition, right whales apparently abandoned~~ the central Gulf of Maine in winter (~~see~~ Cole *et al*. 2013) have also not been detected since 2011 (NMFS unpublished data), but ~~in have since been seen in~~ large numbers of right whales have been documented~~, and both~~ feeding and socializing ~~observed, in a region~~ south of Martha's Vineyard and Nantucket Islands (Leiter *et al*. 2017; Stone *et al*. 2017; Quintana-Rizzo *et al*. 2021), an area outside of the 2016 Northeastern U.S. Foraging Area Critical Habitat. Right whale presence in this area is nearly year round, including in summer months. The highest sighting rates in this area are between December and May~~from winter through early spring~~, when ~~;~~close to a quarter of the population may be present at any given time~~ between December and May~~. The age and sex of the whales using this area did not vary significantly from that of the population (Quintana-Rizzo *et al*. 2021). Since 2015, increased acoustic detections and survey effort in the Gulf of St. Lawrence have documented right whale presence there from late spring through the fall (Cole *et al*. 2016; ~~DFO 2020;~~ Simard *et al*. 2019; DFO 2020). Photographic captures of right whales in the Gulf of St. Lawrence during the summers of 2015–2019 documented 48, 50, 133, 132, and 135 unique individuals using the region, respectively, with a total of 187 unique individuals documented over the five summers (Crowe *et al*. 2021).

Genetic analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified seven mtDNA haplotypes in the western North Atlantic right whale population, including heteroplasmy that led to the declaration of the seventh haplotype (Malik *et al*. 1999; McLeod and White 2010). Schaeff *et al*. (1997) compared the genetic variability of North Atlantic and southern right whales (*E. australis*)~~,~~ and found the former to be significantly less diverse, a finding broadly replicated by Malik *et al*. (2000). The low diversity in North Atlantic right whales might indicate inbreeding, but no definitive conclusion can be reached using current data. Modern and historic genetic population structures were compared using DNA extracted from museum and archaeological specimens of baleen and bone. This work suggested that the eastern and western North Atlantic populations were not genetically distinct (Rosenbaum *et al*. 1997, 2000). However, the virtual extirpation of the eastern stock and its lack of recovery in the last hundred years strongly suggest population subdivision over a protracted (but not evolutionary) timescale. Genetic studies concluded that the principal loss of genetic diversity occurred prior to the 18th century (Waldick *et al*. 2002). However, revised conclusions that nearly all the remains in the North American Basque whaling archaeological sites were bowhead whales (*Balaena mysticetus*) and not right whales (Rastogi *et al*. 2004; McLeod *et al*. 2008) contradict the previously held belief that Basque whaling during the 16th and 17th centuries was principally responsible for the loss of genetic diversity.

High-resolution (*i.e.*, using 35 microsatellite loci) genetic profiling improved the~~our~~ understanding of genetic variability, the number of reproductively active individuals, reproductive fitness, parentage, and relatedness of individuals (Frasier *et al*. 2007, 2009). It has also helped fill gaps in our understanding of the species' age structure, calf development, calf survival, and weaning (Hamilton *et al*. 2022). Because the callosity patterns used to identify individual right whales take months to develop after a whale's birth, ~~One finding of the genetic studies is the importance of o~~obtaining biopsy samples from calves on the calving grounds provides a means of genetically identifying calves later in life~~,~~ or after death. Between 1990 and 2010, only about 60% of all known calves were seen with their mothers in summering areas when their callosity patterns are stable enough to reliably make a photo-ID match later in life. The remaining 40% were not seen on a known summering ground. Because the calf's genetic profile is the most~~only~~ reliable way to establish parentage, if the calf is not sampled when associated with its mother early on, ~~then it is not possible to link it with a calving event or to its mother, and~~ information such as age and familial relationships may be ~~is~~ lost. From 1980 to 2001, there were 64 calves born that were not sighted later with their mothers and thus unavailable to provide age-specific mortality information (Frasier *et al*. 2007). Hamilton *et al*. (2022) reported that of the 470 calves observed between 1998 and 2018, 370 (78.7%) were biopsied, 293 as calves and 77 later in life, their identification linked by photographs. Of the 100 calves not biopsied during this period, 32 were sufficiently photographed to allow subsequent identification and aging, but 68 had yet to be identified other than as a unique calf.

Frasier (2007b) genetically examined the paternity of 87 calves born between 1980 and 2001. Although genetic profiles were available for 69% of all potential fathers in the population, paternity was assigned to only 51% of the calves, and all the sampled males were excluded as fathers of the remaining calves. The findings suggested that either the unsampled males were particularly successful~~,~~ or that the population of males, and the population as a whole, was larger than suggested by the photo-identification data (Frasier 2007b). However, a~~A recent~~ study comparing photo-identification and pedigree genetic data for animals known or presumed to be alive during 1980–2016 found that the presumed alive estimate is similar to the actual abundance of this population, which indicates that the majority of the animals have been photo-identified (Fitzgerald 2018).

POPULATION SIZE

Estimation of ~~T~~the western North Atlantic right whale stock size is based on a published state-space model of the sighting histories of individual whales identified using photo-identification techniques (Pace *et al*. 2017; Pace 2021). Sightings histories were constructed from the photo-ID recapture database as it existed in December~~January~~ 2021~~,~~ and included photographic information up through November 2020~~19~~. Using a hierarchical, state-space Bayesian open population model of these histories produced a median abundance value (Nest) as of 30 November 2020~~19~~ of 33~~6~~8 individuals (95%CI: 325~~56~~-350~~78~~; Table 1). As with any statistically-based estimation process, uncertainties exist in the estimation of abundance because it is based on a probabilistic model that makes certain assumptions about the structure of the data. Because the statistically-based uncertainty is asymmetric about N, the credible interval is used to characterize that uncertainty (as opposed to a CV that may appear in other stock assessment reports).

Table 1. Best and minimum abundance estimates as of 30 November 2020~~19~~ for the western North Atlantic right whale (Eubalaena glacialis) with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r), and PBR.

N_{est}	95% Credible Interval	60% Credible Interval	N_{min}	F_r	R_{max}	PBR
338~~368~~	325–350~~356–378~~	332–343~~364–373~~	332~~364~~	0.1	0.04	0.7

Historical Abundance

The total North Atlantic right whale population size pre-whaling is estimated between 9,075 and 21,328 based on extrapolation of spatially explicit models of carrying capacity in the North Pacific (Monserrat *et al.* 2015). Basque whalers were thought to have taken right whales during the 1500s in the Strait of Belle Isle region (Aguilar 1986);~~,~~ however, genetic analysis has shown that nearly all of the remains found in that area are, in fact, those of bowhead whales (Rastogi *et al.* 2004; Frasier *et al.* 2007). This stock of right whales may have already been substantially reduced by the time colonists in Massachusetts started whaling in the 1600s (Reeves *et al.* 2001, 2007). A modest but persistent whaling effort along the coast of the eastern U.S. lasted three centuries, and the records include one report of 29 whales killed in Cape Cod Bay in a single day in January 1700. Reeves *et al*. (2007) calculated that a minimum of 5,500 right whales were taken in the western North Atlantic between 1634 and 1950, with nearly 80% taken in a 50-year period between 1680 and 1730. They concluded, "there were at least a few thousand whales present in the mid-1600s." The authors cautioned, however, that the record of removals is incomplete, the results were preliminary, and refinements are required. Based on back calculations using the present population size and growth rate, the population may have numbered fewer than 100 individuals by 1935 when international protection for right whales came into effect (Hain 1975; Reeves *et al.* 1992; Kenney *et al.* 1995). However, little is known about the population dynamics of right whales in the intervening years.

Minimum Population Estimate

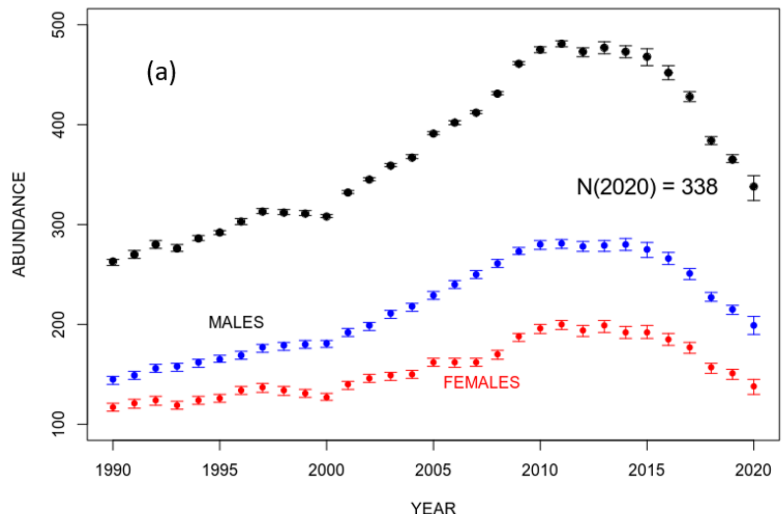
The minimum population estimate is the lower limit of the two-tailed 60% credible interval about the median of the posterior abundance estimates using the methods of Pace *et al*. (2017) and refinements of Pace (2021). This is roughly equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The median estimate of abundance for western North Atlantic right whales is 33~~6~~8, and the minimum population estimate is 332 individuals ~~(~~(based on photographic information through November 2020~~computed November 30, 2021);~~~~. The minimum population estimate as of 30 November 202~~20~~19 is 33~~32~~64 individuals (~~ Table 1).

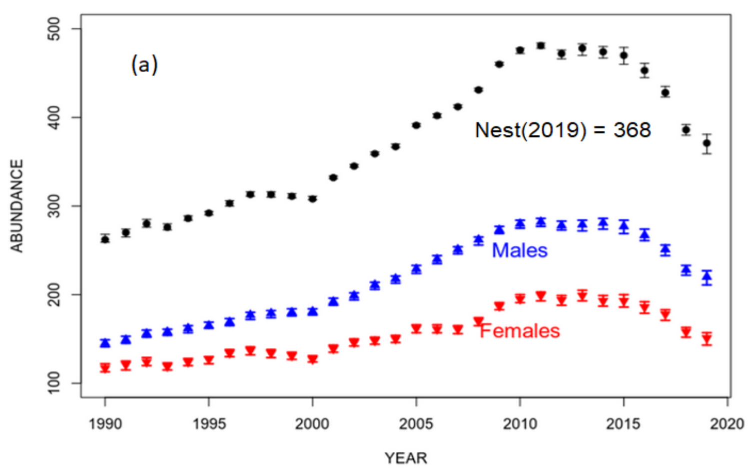
Current Population Trend

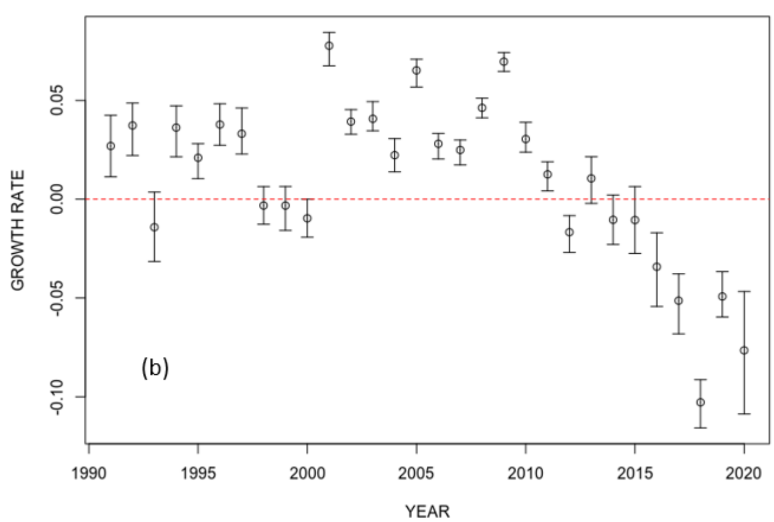
The population growth rate reported for the period of 1986–1992 by Knowlton *et al.* (1994) was 2.5% (CV=0.12), suggesting that the stock was recovering slowly, but that number may have been influenced by the discovery~~by discovery~~ phenomenon as existing whales were recruited to the catalog. Work by Caswell *et al.* (1999) suggested that crude survival probability declined from about 0.99 in the early 1980s to about 0.94 in the late 1990s. The decline was statistically significant. Additional work conducted in 1999 was reviewed by an IWC workshop on status and trends in this population (IWC 2001); the workshop concluded based on several analytical approaches that survival had indeed declined in the 1990s. Although capture heterogeneity could negatively bias survival estimates, the workshop concluded that this factor could not account for the entire observed decline, which appeared to be particularly marked in adult females. Another workshop was convened by NMFS in September 2002, and it reached similar conclusions regarding the decline in the population (Clapham 2002). At the time, the early part of the recapture series had not been examined for excessive retrospective recaptures which had the potential to positively bias the earliest estimates of survival as the catalog was being developed.

Examination of the abundance estimates for the years 1990–2011 (Figures 2a, 2b) suggests that abundance increased at about 2.8% per annum from posterior median point estimates of 270 individuals in 1990 to 481 in 2011, but that there was a 100% chance that abundance declined from 2011 to 2020~~19~~ when the final estimate was 33~~6~~8 individuals. The overall abundance decline between 2011 and 2020~~19~~ was 29.7~~3.5~~% (derived from 2011 and 2020 median point estimates~~CI=21.4% to 26.0%~~). There has been a considerable change in right whale habitat-~~-~~use patterns in areas where most of the population had been observed in previous years (*e.g.*, Davies *et al*. 2017), exposing the population to new anthropogenic threats (Hayes *et al.* 2018). Pace (2021) found a significant decrease in mean survival rates since 2010, correlating with the observed change in area-use patterns (Figure 2c). This apparent change in habitat use also had the effect that, despite relatively constant effort to find whales in traditional areas, the chance of photographically capturing individuals decreased (Figure 3). However, the methods in Pace *et al.* (2017) and Pace (2021) account for changes in capture probability.

There were 17 right whale mortalities reported in 2017 (Daoust *et al.* 2017). This number exceeds the largest estimated annual mortality rate during the past 25 years. Further, despite high survey effort, only 5 and 0 calves were detected in 2017 and 2018, respectively. In 2019, 7 calves were identified, and in 2020, 10 calves were documented ~~found~~ (Pettis *et al.* 2021).


(a)
ABUNDANCE
YEAR
N(2020) = 338
MALES
FEMALES


(a)
ABUNDANCE
YEAR
Nest(2019) = 368
Males
Females


(b)
GROWTH RATE
YEAR

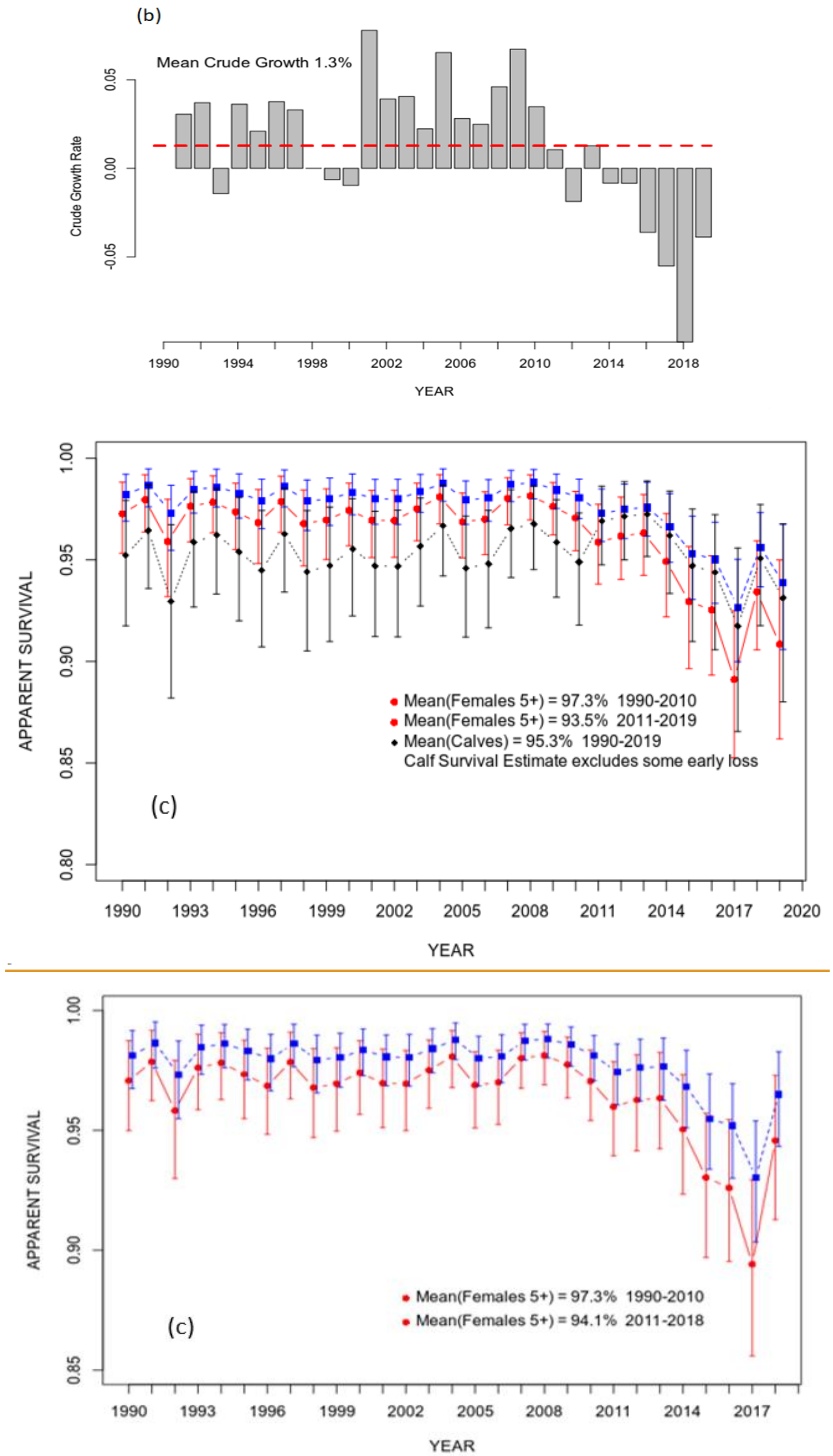
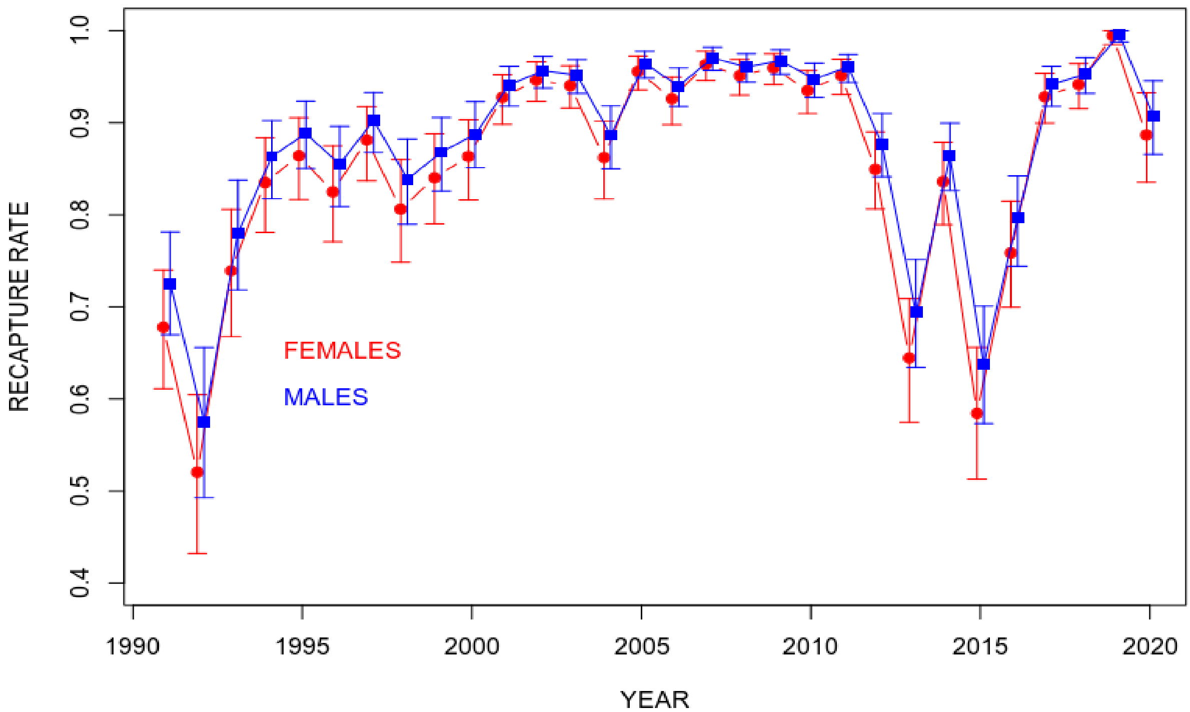


Figure 2. (a) Abundance estimates for North Atlantic right whales. Estimates are the median values of a posterior distribution from modeled capture histories. Also shown are sex-specific abundance estimates. Cataloged whales may include some but not all calves produced each year. (b) A~~Crude a~~nnual growth rates from the abundance

values. ~~and associated 95% credible intervals.~~ (c) Sex-specific survival rate estimates. All graphs show associated 95% credible intervals.


RECAPTURE RATE
FEMALES
MALES
YEAR

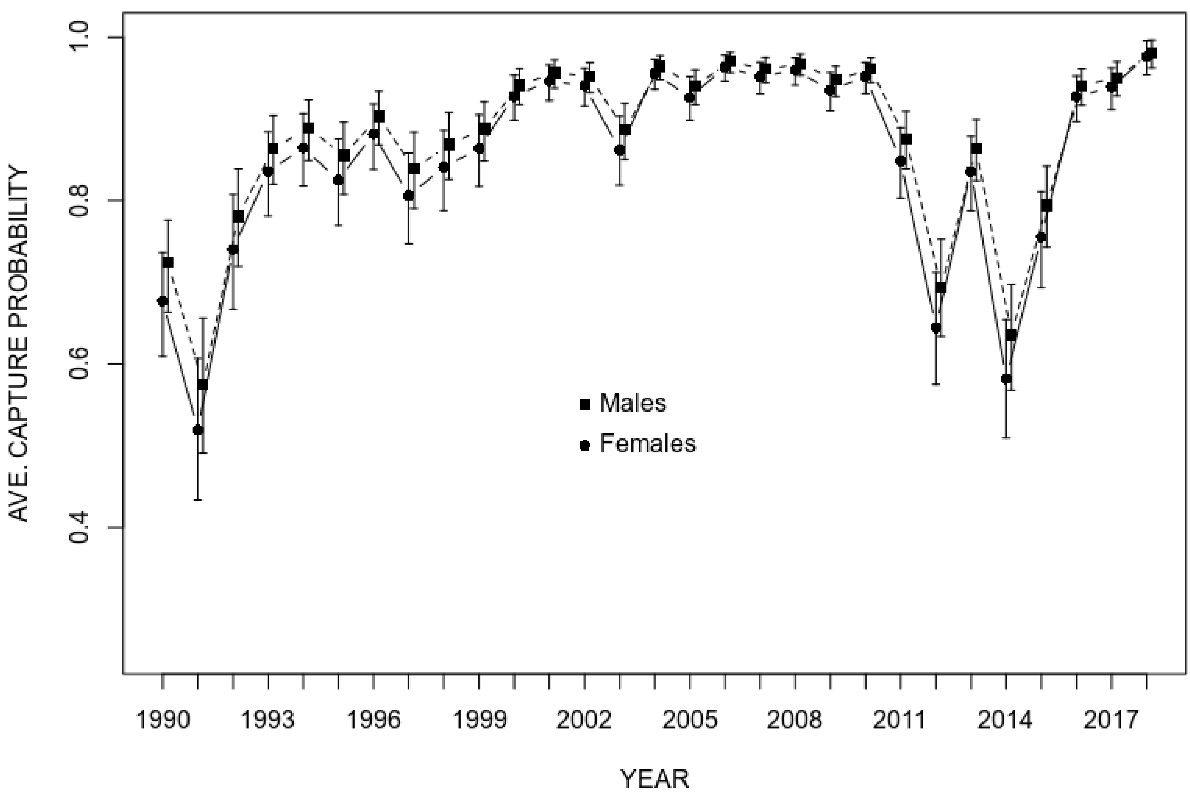
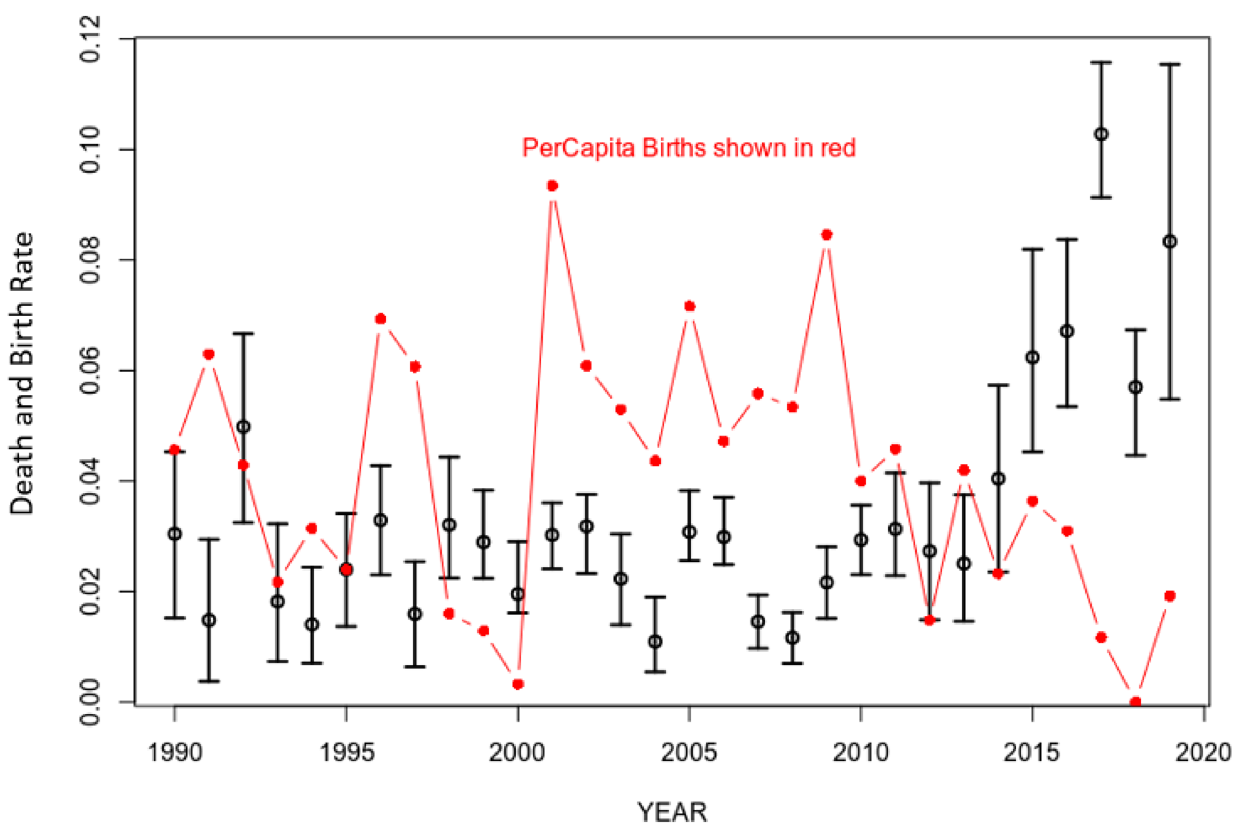

AVE. CAPTURE PROBABILITY
Males
Females
YEAR

Figure 3. Estimated recapture probability and associated 95% credible intervals of North Atlantic right whales 1990–2018 based on a Bayesian mark-resight/recapture model allowing random fluctuation among years for survival rates, treating capture rates as fixed effects over time, and using both observed and known states as data (from Pace et al. 2017). Males are shown in blue with squares;~~,~~ females are shown in red with circles.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

During 1980–1992, at least 145 calves were born to 65 identified females. The number of calves born annually ranged from 5 to 17, with a mean of 11.2 (SE=0.90). The reproductively active female pool was static at approximately 51 individuals during 1987–1992. Mean calving interval, based on 86 records, was 3.67 years. There was an indication that calving intervals may have been increasing over time, although the trend was not statistically significant (P=0.083) (Knowlton *et al.* 1994). Since 1993, calf production has been more variable than a simple stochastic model would predict.

During 1990–2020~~19~~, at least 48~~6~~1 calves were born into the population. The number of calves born annually ranged from 0 to 39~~,~~ and averaged 15 but was highly variable (SD=9.1). No calves were born in the winter of 2017–2018. The fluctuating abundance observed from 1990 to 2020~~19~~ makes interpreting a count of calves by year less clear than measuring population productivity, which we index by dividing the number of detected calves by the estimated size of the population each year (Apparent Productivity Index ~~or~~ [API]). Productivity for this stock has been highly variable over time and has been characterized by periodic swings in per capita birth rates (Figure 4). Notwithstanding the high variability observed, as expected for a small population, productivity in North Atlantic right whales lacks a definitive trend. Corkeron *et al.* (2018) found that during 1990–2016, calf count rate increased at 1.98% per year with outlying years of very high and low calf production. This is approximately a third of that found for three different southern right whale (*Eubalaena australis)* populations during the same time period (5.3–7.2%). Based on the most recent population estimate, there are approximately 68 ~~“proven”~~ females known to have calved ~~(i.e. those who are known to have reproduced)~~ that are likely (>~~with a~~ 50% ~~or greater~~ probability) ~~of being~~ still alive.



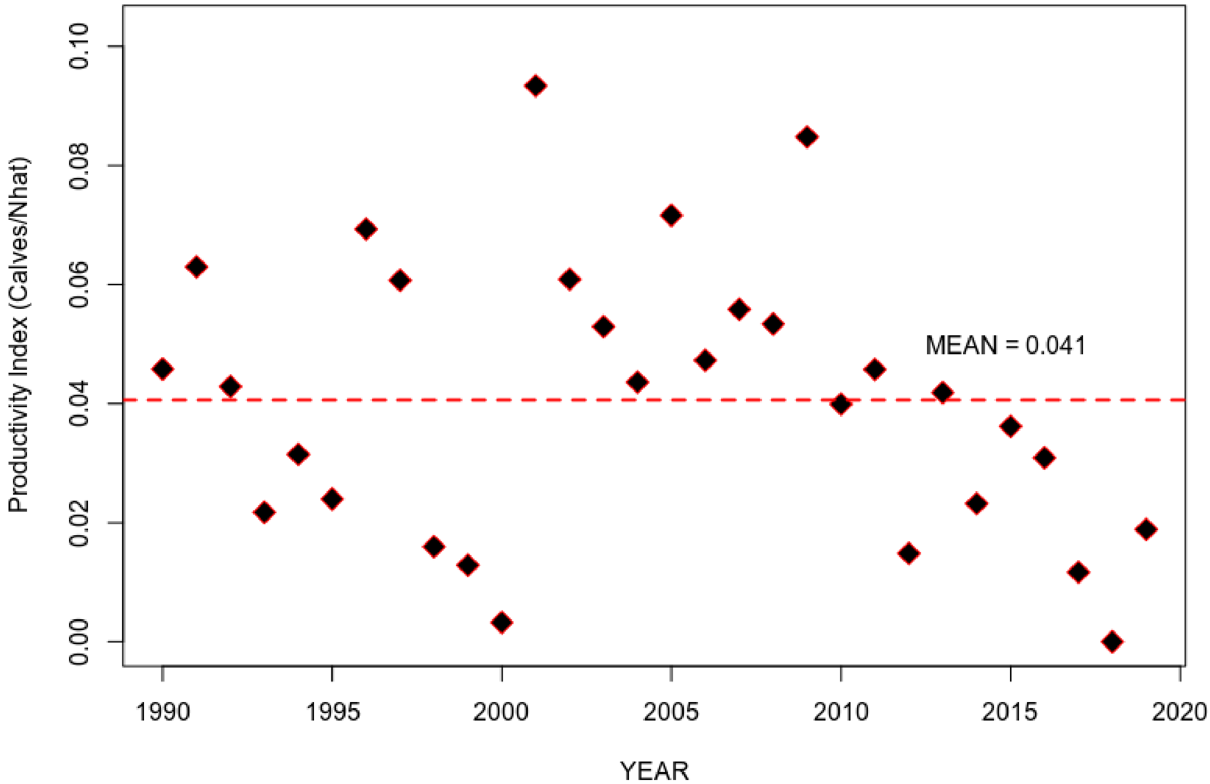


Figure 4. ***North Atlantic right whale per capita birth rate (red line, closed circles) and death rate with associated 95% credible intervals, 1990—2019.~~Productivity in the North Atlant the estimated population size for each year.ic right whale population as characterized by calves detected divided by~~***

The available evidence suggests that at least some of the observed variability in the calving rates of North Atlantic right whales is related to variability in nutrition (Fortune *et al.* 2013). There is also clear evidence that North Atlantic right whales are growing to shorter adult lengths than in earlier decades (Stewart *et al.* 2021) and are in poor body condition compared to southern right whales (Christiansen *et al.* 2020). All these changes may result from a combination of documented regime shifts in primary feeding habitats (Meyer-Gutbrod and Greeene 2014; Meyer-Gutbrod *et al.* 2021; Record *et al.* 2019)~~,~~ and increased energy expenditures related to non-lethal entanglements (Rolland *et al.* 2016; Pettis *et al.* 2017; van der Hoop 2017). ~~Only non-lethal entanglements can be affected by management intervention, and d~~Despite ~~recent~~ management actions, overall entanglement rates ~~(~~as measured by the rate at which scars are acquired by living North Atlantic right whales~~;~~ (Hamilton *et al.* 2020; Figure~~.~~ 5 ~~here~~) remain high. As such, entanglement will continue to impact calving rates, and the declining trend in abundance will likely continue.

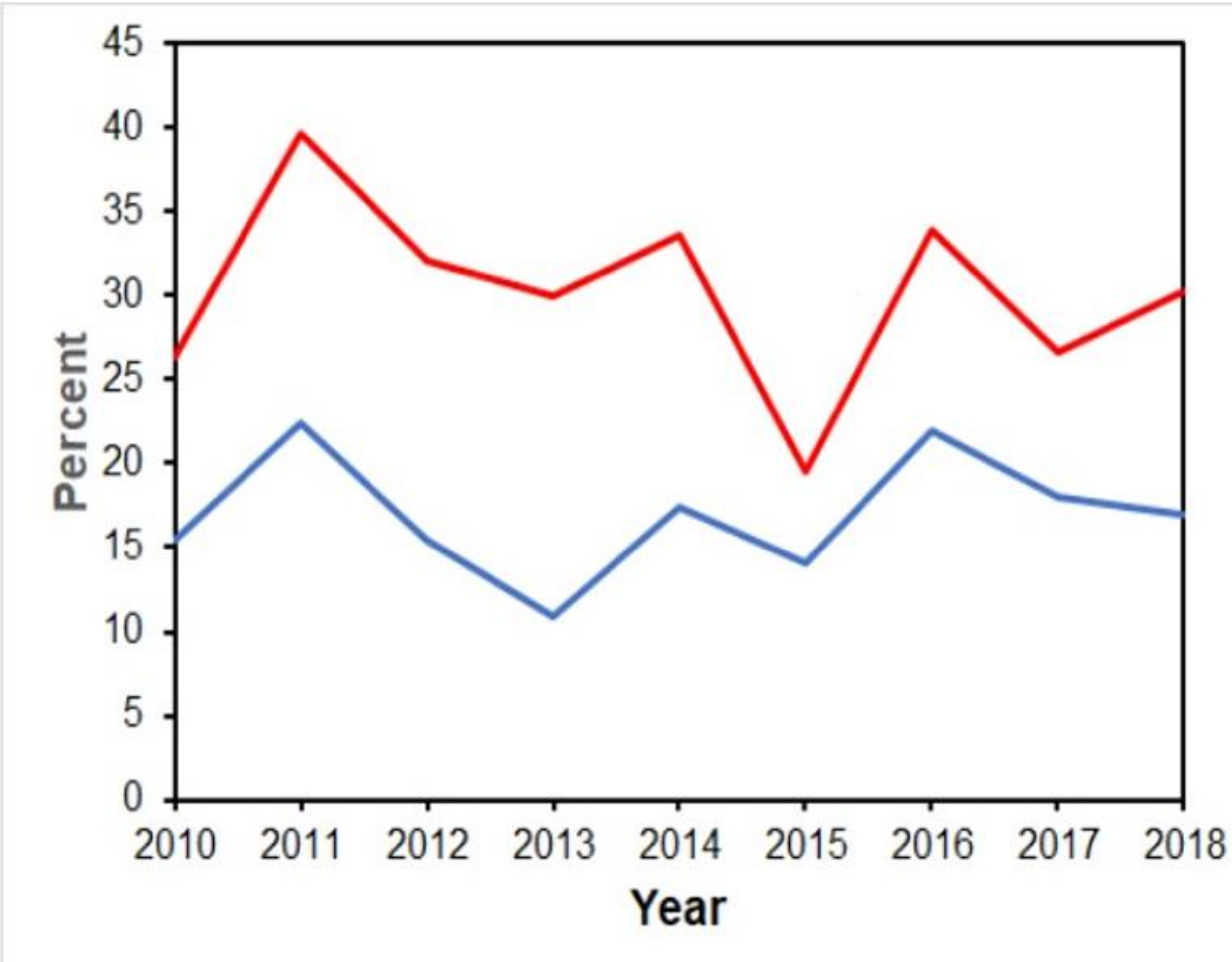


Figure 5. North Atlantic right whale entanglement rates estimated by monitoring scars on living whales. The~~:~~ crude entanglement rate (blue line) is the proportion of whales seen with ~~—~~newly discovered entanglement scars~~ as a proportion of whales seen)~~; t~~. ~~he year the scar was detected may not represent the year the entanglement occurred. The ~~;~~ annual entanglement rate (red line) is the minimum rate of entanglement, derived from ~~—~~proportion of ~~adequately photographed~~ whales with new scars that were adequately photographed in both years of sequential combinations~~,~~ (e.g., 2017/2018~~) (d. D~~; data from Hamilton et al. ~~(~~2020).

~~The available evidence suggests that at least some of the observed variability in the calving rates of North Atlantic right whales is related to variability in nutrition (Fortune *et al.* 2013) and possibly increased energy expenditures related to non-lethal entanglements (Rolland *et al.* 2016; Pettis *et al.* 2017; van der Hoop 2017).~~

An analysis of the age structure of this population suggested that it contained a smaller proportion of juvenile whales than expected (Hamilton *et al.* 1998; IWC 2001), which may reflect lowered recruitment and/or high juvenile mortality. Calf and perinatal mortality was estimated by Browning *et al.* (2010) to be between 17 and 45 animals during the period 1989 and 2003. In addition, it is possible that the apparently low reproductive rate is due in part to an unstable age structure or to reproductive dysfunction in some females. However, few data are available on either factor, and senescence has not been documented for any baleen whale.

The maximum net productivity rate is unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be the default value of 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). Projection models suggest that this rate could be 4% per year if female survival was the highest recorded over the time series from Pace *et al.* (2017). Reviewing the available literature, Corkeron *et al.* (2018)

showed that female mortality is primarily anthropogenic~~,~~ and concluded that anthropogenic mortality has limited the recovery of North Atlantic right whales. In a similar effort, Kenney (2018) back-projected a series of scenarios that varied entanglement mortality from observed to zero. Using a scenario with zero entanglement mortality, which included 15 “~~"~~surviving”~~"~~ females, and a five-year calving interval, the projected population size including 26 additional calf births would have been 588 by 2016. Single-year production has exceeded 0.04 in this population several times, but those outputs are not likely sustainable given the 3-year minimum interval required between successful calving events and the small fraction of reproductively active females. This is likely related to synchronous calving that can occur in capital breeders under variable environmental conditions. Hence, uncertainty exists as to whether the default value is representative of maximum net productivity for this stock, but it is unlikely that it is much higher than the default.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is the product of minimum population size, one-half the maximum net productivity rate and a recovery factor for endangered, depleted, or threatened stocks, or stocks of unknown status relative to OSP (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The recovery factor for right whales is 0.1 because this species is listed as endangered under the Endangered Species Act (ESA). The minimum population size is 332~~64~~. The maximum productivity rate is 0.04, the default value for cetaceans. PBR for the western North Atlantic stock of the North Atlantic right whale is 0.7 (Table 1).

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2016~~5~~ through 2020~~19~~, the annual detected (*i.e.*, observed) human-caused mortality and serious injury to right whales averaged 8.1~~7.557~~ individuals per year (Table 2). This is derived from two components: 1) incidental fishery entanglement records at 5.7 per year~~,~~ and 2) vessel strike records averaging 2.4~~0~~ per year.

Injury determinations are made based upon the best available information; these determinations may change with the availability of new information (Henry *et al.* *2022*~~*in review*~~). Only records considered to be confirmed human-caused mortalities or serious injuries are reported in the observed mortality and serious injury (M/SI) rows of Table 2.

Annual rates calculated from detected mortalities are a negatively-biased accounting of human-caused mortality; they represent a definitive lower bound. Detections are irregular, incomplete, and not the result of a designed sampling scheme. Research on other cetaceans has shown the actual number of deaths can be several times higher than observed (Wells *et al.* 2015; Williams *et al*. 2011). The hierarchical Bayesian, state-space model used to estimate North Atlantic right whale abundance (Pace *et al.* 2017) can also be used to estimate total mortality. The estimated ~~annual~~ rate of total mortality using this modeling approach is 31.2~~27.4~~ animals per year, or 156 animals total, for the period 2015~~4~~–2019~~8~~ (Pace *et al.* 2021). This estimated total mortality accounts for detected mortality and serious injury (injuries likely to lead to death), as well as undetected (cryptic) mortality within the population. Figure 6~~5~~ shows the estimates of total mortality for 1990–2019~~8~~ from the state-space model. ~~Using the methods of Pace *et al.* 2021, t~~The 31.2 estimated annual rate of total mortality ~~rate~~ for the 5-year period 2015–2019 ~~(31.2)~~ using the methods of Pace *et al.* (2021)~~ is 31.2 156~~ is 4.1 times higher than the 7.7 detected mortality and serious injury value reported for the same period in the previous stock assessment report.~~ The annual detection rate of mortality and serious injury for the 5-year period 20154–20198 was 12 38.529.7% of the model's annual mortality estimates, which is 2.63.4 times larger than the 8.15 total detected mortalities and serious injuries during 20154–20198 when including both serious injuries that could not be assigned to cause and all prorated injury events.~~ The estimated mortality for 2020~~19~~ is not yet available because it is derived from a comparison with the population estimate for 2021~~0~~, which, in turn, is contingent on the processing of all photographs collected through 2021~~0~~ for incorporation into the state-space model of the sighting histories of individual whales. An analysis of right whale mortalities between 2003 and 2018 found that of the examined non-calf carcasses for which cause of death could be determined, all mortality was human-caused (Sharp~~e~~ *et al.* 2019). Based on these findings, 100% of the estimated mortality of 31.2~~27.4~~ animals per year is assumed to be human-caused. This estimate of total annual human-caused mortality may be somewhat positively biased (*i.e*., a slight overestimate) given that some calf mortality is likely not human-caused.

There is currently insufficient information to apportion the estimated total right whale mortality to that ~~by country, e.g.,~~ occurring in U.S. ~~versus Canadian~~ waters. To a~~A~~pportion~~ing~~ the estimated total right whale mortality by cause~~,~~ (*e.g.*, entanglement versus vessel collision), we used the proportion of observed mortalities and serious injuries ~~and mortalities~~ from entanglement compared to those from vessel collision for the period 2016–2020. During this period, 71% of the observed mortality and serious injury ~~and mortality~~ was the result of entanglement and 29% was from vessel collisions. Applying these proportions to the estimated total mortality (156) -provides an estimate of 110~~1~~ total entanglement deaths and 46~~5~~ total vessel collision deaths during 2016–2020 (Table 2).~~ observed incidental fishery-related serious injuries and mortalities for 2016-2020. During this period, there was a total of XX entanglement serious injuries and XX entanglement mortalities during 20also remains uncertain at this time. Pace *et al.* (2021) suggest that entanglements account for more than twice the number of cryptic deaths compared to vessel collisions based on the preponderance of entanglement serious injuries; f~~ These estimates may be biased~~A potential issue with this method is~~ if there is significant bias in the detection of entanglement versus vessel collision serious injuries. From 1990 to 2017, NMFS determined a total of 62 right whales were seriously injured, and of these, 54 (87%) were due to entanglement. However, during the same period, of 41 right whale carcasses examined for cause of death, 21 (51%) were attributed to vessel collision and 20 (49%) to entanglement. Moore *et al.* (2004) and Sharpe *et al.* (2019) theorized ~~suggest~~ that the underrepresentation of entanglement deaths in examined carcasses may be the result of weight loss in chronically entangled whales, who can become negatively buoyant and sink at the time of death, whereas whales killed instantly by vessel collision may remain available for detection for a longer period and are more likely to be recovered for examination. However, ~~the~~ floating carcasses of whales ~~killed instantly~~ will ~~only~~ drift ~~move~~ with wind and currents, and may not be carried into areas where detection is likely, whereas entangled whales may continue to swim for months and move into areas patrolled by survey teams. An initial review of the serious injury and mortality records maintained by the NMFS Greater Atlantic and Southeast Regional Offices between 2001–2020 found that 59% of all right whale serious injuries were first documented by survey teams, but only 19% of right whale carcasses were first discovered by survey teams. The visibility of some entanglements may~~can~~ ~~also~~ add to the likelihood of serious injury detection, whereas blunt trauma from a vessel collision may~~is~~ not be externally detectable. Both Pace *et al*. (2021) and Moore *et al*. (2020) recommend continued research into the potential mechanisms creating the disparity between apparent causes of serious injuries and necropsy results.

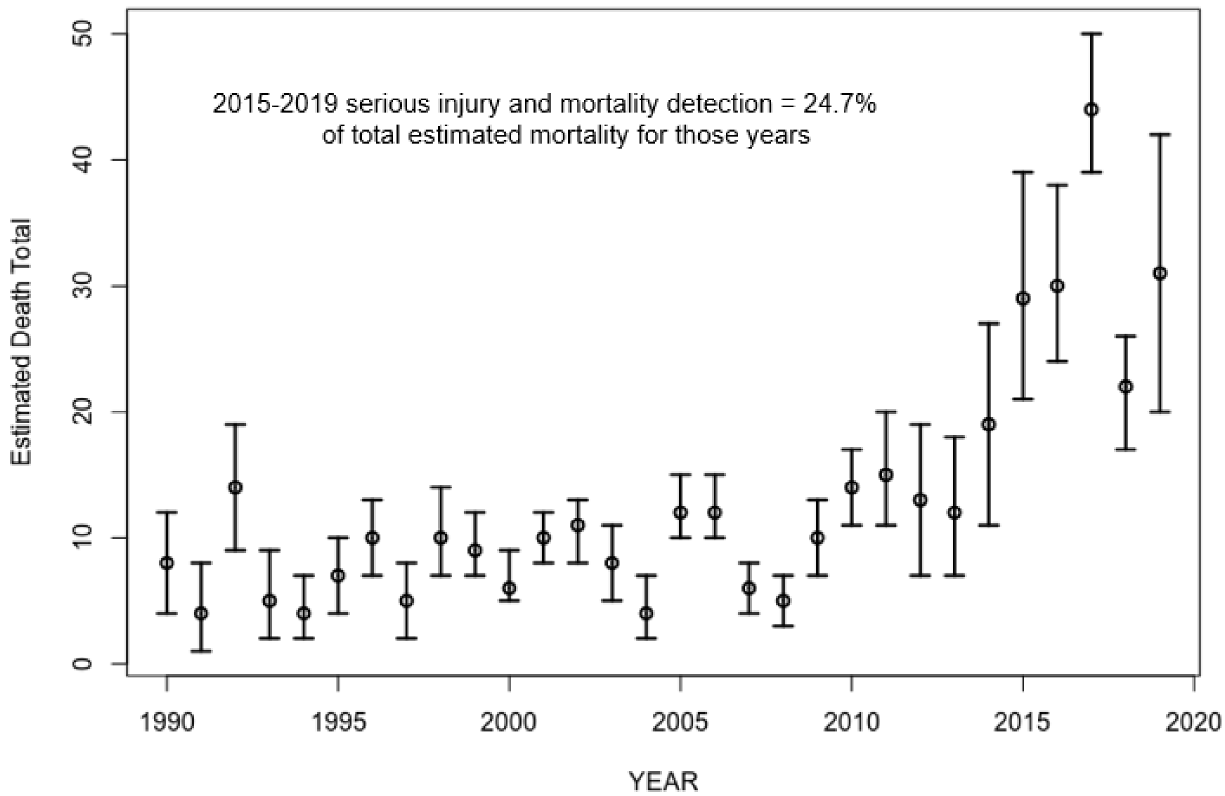
Table 2. A~~verage a~~nnual estimated and observed~~ and estimated total~~ human-caused mortality and serious injury for the North Atlantic right whale (Eubalaena glacialis)~~ from 20165 through 202019~~. Observed values are from confirmed interactions from 2016–2020. Estimated total mortality is ~~model~~ derived from annual population estimates from 2015–2019 (Pace et al. 2017; Pace et al. 2021). ~~Fishery related serious injuries prevented are a result of successful disentanglement efforts.~~

Years	**Source**	**Total**	**Annual Average**
2015–2019	**Estimated total mortality**	**156**	**31.2**
	Estimated incidental fishery-related mortality	**110**	**22.0**
	Estimated vessel collision mortality	**46**	**9.2**
2016–2020	Observed total human-caused M/SI[a]	40.5	8.1
	Observed incidental fishery-related M/SI[a,b]	28.5	5.7
	Observed vessel collision M/SI[a]~~1~~	12	2.4
	Fishery-related SI prevented[c]	6	1.2
	~~Estimated total mortality~~	~~156~~	~~31.2~~
	~~Estimated incidental fishery-related mortality~~	~~111~~	~~22.2~~
	~~Estimated vessel collision mortality~~	~~45~~	~~9~~

a. Observed serious injury events with decimal values were counted as 1 for this comparison.
b. The observed incidental fishery interaction count does not include fishery-related serious injuries that were prevented by disentanglement.
c. Fishery-related serious injuries prevented are a result of successful disentanglement efforts.

~~**Years**~~	~~**Source**~~	~~**Annual Average**~~
~~2015–2019~~	~~Observed incidental fishery-related M/SI~~	~~65.75*~~
~~2015–2019~~	~~Observed vessel collisions~~	~~12.0~~
~~2015–2019~~	~~Observed total human-caused M/SI~~	~~87.7~~

~~2015–2019~~	~~Estimated total mortality~~	~~127.4~~
~~2015–2019~~	~~Fishery-related SI prevented~~	~~1.6~~



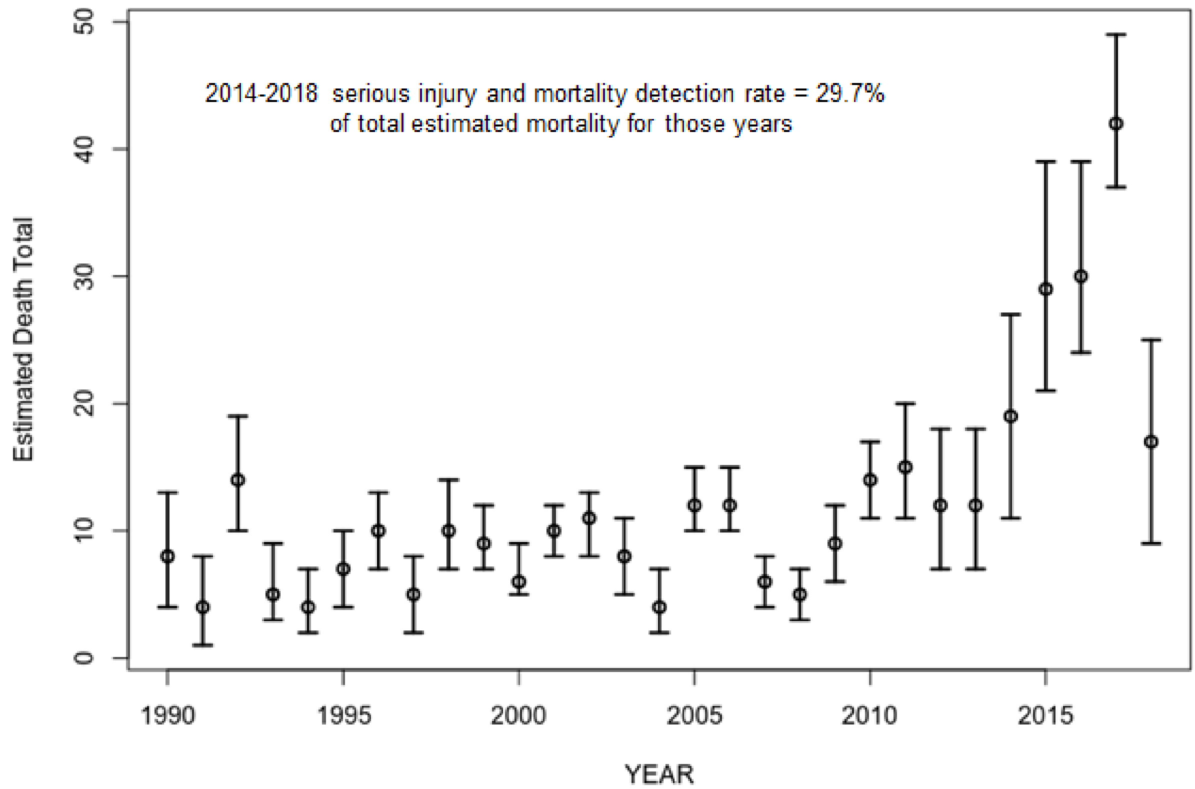


Figure 6~~5~~. Time series of estimated total right whale mortalities, 1990–2019.

The small population size and low annual reproductive rate of right whales suggest that human sources of mortality have a greater effect relative to population growth rates than for other whale species (Corkeron *et al.* 2018). The principal factors ~~believed to be~~ preventing growth and recovery of the population are~~is~~ entanglement and vessel strikes~~with fishing gear (Kenney 2018)~~. Between 1970 and 2018, ~~a total of~~ 124 right whale mortalities were~~was~~ recorded (Knowlton and Kraus 2001; Moore *et al.* 2005; Sharp *et al.* 2019). Of these, 18 (14.5%) were neonates that were believed to have died from perinatal complications or other natural causes. Of the remainder, 26 (21.0%) resulted from vessel strikes, 26 (21.0%) were related to entanglement in fishing gear, and 54 (43.5%) were of unknown cause. At a minimum, therefore, 42% of the observed total for the period and 43% of the 102 non-calf deaths were attributable to human impacts (calves accounted for six deaths from vessel strikes and two from entanglements). However, when considering only those cases where cause of death could be determined, 100% of non-calf mortality was human-caused. Hayes *et al.* (2018) reported ~~A recent analysis of human-caused serious injury and mortality during 2000–2017 shows that entanglement injuries have been~~ an increasing trend in entanglement mortality and serious injuries during 2000-2017, ~~steadily over the past twenty years~~ while ~~mortality and serious injuries from~~ vessel strikes had~~ve shown~~ no specific trend despite several reported cases in 2017. ~~(Hayes *et al.* 2018).~~ Detected vessel strike mortalities were again relatively numerous in 2019, and in 2020, one calf was seriously injured and another killed by vessel strikes in U.S. waters (Table 3).

The details of a particular mortality or serious injury record often require a degree of interpretation (Moore *et al.* 2005; Sharp *et al.* 2019). The cause of death is based on analysis of the available data; additional information may result in revisions. When reviewing Table 3 below, several factors should be considered: 1) a vessel strike or entanglement may have occurred at some distance from the location where the animal is detected/reported; 2) the mortality or injury may involve multiple factors~~; for example,~~ (e.g., whales that have been both vessel struck and entangled are not uncommon); 3) the actual vessel or gear type/source is often uncertain; and 4) entanglements may involve several types of gear. Beginning with the 2001 Stock Assessment Report, Canadian records have been incorporated into the mortality and serious injury rates to reflect the effective range of this stock. However, because whales have been known to carry gear for long periods of time and over great distances before being detected, and recovered gear is often not adequately marked, it can be difficult to assign some entanglements to the country of origin.

It should be noted that entanglement and vessel collisions may not seriously injure or kill an animal directly~~,~~ but may weaken or otherwise affect a whale's reproductive success (van der Hoop *et al.* 2017; Corkeron *et al.* 2018; Christiansen *et al.* 2020; Stewart *et al.* 2021). The NMFS serious injury determinations for large whales commonly include animals carrying gear when these entanglements are constricting or are determined to interfere with foraging (Henry *et al*. 2022~~*in review*~~). Successful disentanglement and subsequent resightings of these individuals in apparent good health are criteria for downgrading an injury to non-serious. However, these and other non-serious injury determinations should be considered to fully understand anthropogenic impacts to the population, especially in cases where females' fecundity may be affected.

Fishery-Related Mortality and Serious Injury

Not all mortalities are detected, but reports of known mortality and serious injury relative to PBR, as well as total human impacts, are contained in the records maintained by the New England Aquarium and the NMFS Greater Atlantic and Southeast Regional Offices. Records were reviewed, and those determined to be human-caused are detailed in Table 3. Information from an entanglement event often does not include the detail necessary to assign the entanglements to a particular fishery or location.

Although disentanglement is often unsuccessful or not possible for many cases, there are several documented cases of entanglements for which the intervention by disentanglement teams averted a likely serious-injury determination. See Table 2 for the annual average of serious injuries prevented by disentanglement.

Whales often free themselves of gear following an entanglement event, and as such, scarring may be a better indicator of fisheries interaction rates than entanglement records. Scarring rates suggest that entanglements occur at about an order of magnitude more often than detected from observations of whales with gear on them. Knowlton et al. (2012) ~~A~~ reviewed ~~of~~ scarrings ~~detected~~ on identified individual right whales over a period of 30 years (1980–2009), documenting~~ed~~ 1,032 definite, unique entanglement events on the 626 individual whales ~~identified (Knowlton *et al*. 2012)~~. Most individual whales (83%) were entangled at least once, and over half of them (59%) were entangled more than once. About a quarter of the individuals identified in each year (26%) were entangled in that year. Juveniles and calves were entangled at higher rates than were adults. Moore *et al.* (2021) reported that -between 1980 and 2017, 86.1% (642 of 746) individual whales identified had evidence of entanglement interactions. ~~More recently,~~ A~~a~~nalysi~~e~~s of whales carrying entangling gear also suggest that entanglement wounds have become more severe since 1990, possibly due to increased use of stronger lines in fixed fishing gear (Knowlton *et al*. 2016).

Knowlton *et al.* (2012) concluded from their analysis of entanglement scarring rates from 1980–2009 that efforts of the prior decade to reduce right whale entanglement had not worked. Using a completely different data source (observed mortalities of eight large whale species, 1970–2009), van der Hoop *et al.* (2012) arrived at a similar conclusion. Similarly, Pace *et al.* (2015), analyzing entanglement rates and serious injuries due to entanglement during 1999–2009, found no support that mitigation measures implemented prior to 2009 had been effective at reducing takes due to commercial fishing. Since 2009, new entanglement mitigation measures (72 FR 193, 05 October 2007; 79 FR 124, 27 June 2014) have been implemented as part of the Atlantic Large Whale Take Reduction Plan, but their effectiveness has yet to be evaluated. One difficulty in assessing mitigation measures is the need for a statistically ~~-~~significant time series to determine effectiveness.

Other Mortality

Vessel strikes are a major cause of mortality and injury to right whales (Kraus 1990; Knowlton and Kraus 2001, van der Hoop *et al.* 2012). Records from 2016~~5~~ through 2020~~19~~ have been summarized in Table 3. Early analyses of the effectiveness of the vessel-strike rule were reported by Silber and Bettridge (2012). V~~v~~an der Hoop *et al.* (2015) concluded that large whale mortalities due to vessel strikes appeared to have decreased inside active seasonal management areas (SMAs) but ~~and~~ increased outside inactive SMAs. T~~, but t~~hey suggested increasing spatial coverage to improve the Rule's effectiveness. Analysis by Laist *et al.* (2014) incorporated an adjustment for drift around areas regulated under the vessel-strike rule and produced weak evidence that the rule was effective inside the SMAs. Hayes et al. (2018) found there was no apparent trend up or down in vessel ~~ship~~ strike serious injury and mortality between 2000 and 2017 ~~W~~when simple logistic regression models fit using maximum likelihood-based estimation procedures were applied to ~~previously~~ reported vessel strikes~~, between 2000 and 2017, there was no apparent trend (Hayes *et al.* 2018)~~. NMFS (2020) found that compliance with~~to~~ the vessel strike rule varied across the right whale's range in U.S. waters. In 2018-2019, ten years after the rule's enactment, compliance in seasonal management areas from Delaware northward exceeded 85%. Morehead City also exceeded 85%, and the Southeast seasonal management area compliance was 84.6%. Lower compliance rates were noted for the Chesapeake (78%) and North Carolina to Georgia (69%) seasonal management areas. Compliance varied considerably by vessel type; fishing vessels showed the highest level of compliant transit (93%) while other cargo and pleasure vessels had low levels of compliance (44% and 31%, respectively). Using simple biophysical models, Kelley *et al*. (2020) determined that whales can be seriously injured or killed by vessels of all sizes~~,~~ and that collision with a 50-ton fishing vessel transiting at 7 knots has a probability of lethality greater than 50%.

An Unusual Mortality Event was established for North Atlantic right whales in June 2017 due to elevated strandings along the Northwest Atlantic Ocean coast, especially in the Gulf of St. Lawrence region of Canada ~~(https://www.fisheries.noaa.gov/national/marine-life-distress/2017-20210-north-atlantic-right-whale-unusual-mortality-event)~~. There were 33~~0~~ dead whales documented through December 2020~~19~~, with 19~~17~~ whales having evidence of vessel strike or entanglement as the preliminary cause of death. Additionally, 12~~eight~~ free-swimming whales were documented as being seriously injured (11 due to entanglements and 1 due to vessel strike), and 34 more were documented with sublethal injuries and/or illness (27 due to entanglements, 1 due to vessel strike, and 6 of unknown cause) during the time period. Therefore, through December 2020~~19~~, the number of whales included in the UME was 7~~3~~8, including 33~~0~~ dead, ~~and~~ 12~~8~~ seriously injured, and 34 sublethally injured and/or ill.~~ free-swimming whales~~. UME updates are available at (https://www.fisheries.noaa.gov/national/marine-life-distress/2017-20210-north-atlantic-right-whale-unusual-mortality-event)[1].

Table 3. Confirmed human-caused mortality and serious injury records of right whales: 2016~~5~~–2020~~19~~[a]

Date[b]	Fate	ID	Location[b]	Assigned Cause	Value against PBR[c]	Country[d]	Gear Type[e]	Description
~~04/06/2015~~	~~Serious Injury~~	~~C4370~~	~~Cape Cod Bay, MA~~	~~EN~~	~~1~~	~~XU~~	~~NP~~	~~Encircling laceration at fluke insertion with potential to affect major artery. Source of injury likely constricting entanglement. No gear present. Evidence of health decline. No resights.~~
~~06/13/2015~~	~~Prorated Injury~~	~~-~~	~~off Westport, NS~~	~~EN~~	~~.75~~	~~XC~~	~~NR~~	~~Line through mouth, trailing 300-400m ending in 2 balloon-type buoys. Full entanglement configuration unknown. No resights.~~
~~09/28/2015~~	~~Prorated Injury~~	~~-~~	~~off Cape Elizabeth, ME~~	~~EN~~	~~.75~~	~~XU~~	~~NR~~	~~Unknown amount of line trailing from flukes. Attachment point(s) and configuration unknown. No resights.~~
~~11/29/2015~~	~~Serious Injury~~	~~3140~~	~~off Truro, MA~~	~~EN~~	~~1~~	~~XU~~	~~NR~~	~~New, significant ent. injuries indicating constricting wraps. No gear visible. In poor cond. with grey skin and heavy cyamid coverage. No resights.~~
01/29/2016	Serious Injury	1968	off Jupiter Inlet, FL	EN	1	XU	NP	No gear present, but evidence of recent entanglement of unknown configuration. Significant health decline: emaciated, heavy cyamid coverage, damaged baleen. Resighted in April 2017 still in poor cond.
05/19/2016	Serious Injury	3791	off Chatham, MA	EN	1	XU	NP	New entanglement injuries on peduncle. Left pectoral appears compromised. No gear seen. Significant health decline: emaciated with heavy cyamid coverage. No resights post Aug 2016.

1 The number of dead animals, including those where cause of death could be determined, differs in the stock assessment report here from that reported on the UME website because right whale #3920 was seriously injured in 2020 but died in 2021. For the purposes of this stock assessment report, this animal is included during the covered period as a death with a known cause, since the original serious injury leading to death occurred in 2020.

05/03/2016	Mortality	4681	Morris Island, MA	VS	1	US	-	Fresh carcass with 9 deep ventral lacerations. Multiple shorn and/or fractured vertebral and skull bones. Destabilized thorax. Edema, blood clots, and hemorrhage associated with injuries. Proximate COD - sharp trauma. Ultimate COD - exsanguination.
07/26/2016	Serious Injury	1427	Gulf of St Lawrence, QC	EN	1	XC	NP	No gear present, but new entanglement injuries on peduncle and fluke insertions. No gear present. Resights show subsequent health decline: gray skin, rake marks, cyamids.
08/1/2016	Serious Injury	3323	Bay of Fundy, NS	EN	1	XC	NP	No gear present, but new, severe entanglement injuries on peduncle, fluke insertions, and leading edges of flukes. Significant health decline: emaciated, cyamids patches, peeling skin. No resights.
08/13/2016	Serious Injury	4057	Bay of Fundy, NS	EN	1	CN	PT	Free-swimming with extensive entanglement. Two heavy lines through mouth, multiple loose body wraps, multiple constricting wraps on both pectorals with lines across the chest, jumble of gear by left shoulder. Partially disentangled: left with line through mouth and loose wraps at right flipper that are expected to shed. Significant health decline: extensive cyamid coverage. Current entanglement appears to have exacerbated injuries from previous entanglement (see 16Feb2014 event). No resights.
08/16/2016	Prorated Injury	1152	off Baccaro, NS	EN	0.75	XC	NR	Free-swimming with line and buoy trailing from unknown attachment point(s). No resights.
08/28/2016	Serious Injury	2608	off Brier Island, NS	EN	1	XC	NR	Free-swimming with constricting wraps around rostrum and right pectoral. Line trails 50 ft aft of flukes. Significant health decline: heavy cyamid coverage and indication of fluke deformity. No resights.
08/31/2016	Mortality	4320	Sable Island, NS	EN	1	CN	PT	Decomposed carcass with multiple constricting wraps on pectoral with associated bone damage consistent with chronic entanglement.
09/23/2016	Mortality	3694	off Seguin Island, MA	EN	1	CN	PT	Fresh, floating carcass with extensive, constricting entanglement. Thin blubber layer and other findings consistent with prolonged stress due to chronic entanglement. Gear previously reported as unknown.
12/04/2016	Prorated Injury	3405	off Sandy Hook, NJ	EN	0.75	XU	NE	Lactating female. Free-swimming with netting crossing over blowholes and one line over back. Full configuration unknown. Calf not present, possibly already weaned. No resights. Gear type previously reported as NR.

04/13/2017	Mortality	4694	Cape Cod Bay, MA	VS	1	US	-	Carcass with deep hemorrhaging and muscle tearing consistent with blunt force trauma.
06/19/2017	Mortality	1402	Gulf of St Lawrence, QC	VS	1	CN	-	Carcass with acute internal hemorrhaging consistent with blunt force trauma.
06/21/2017	Mortality	3603	Gulf of St Lawrence, QC	EN	1	CN	PT	Fresh carcass found anchored in at least 2 sets of gear. Multiple lines through mouth and constricting wraps on left pectoral. Glucorticoid levels support acute entanglement as COD.
06/23/2017	Mortality	1207	Gulf of St Lawrence, QC	VS	1	CN	-	Carcass with acute internal hemorrhaging consistent with blunt force trauma.
07/04/2017	Serious Injury	3139	off Nantucket, MA	EN	1	XU	NP	No gear present, but evidence of recent extensive, constricting entanglement and health decline. No resights.
07/06/2017	Mortality	-	Gulf of St Lawrence, QC	VS	1	CN	-	Carcass with fractured skull and associated hemorrhaging. Glucorticoid levels support acute blunt force trauma as COD.
07/19/2017	Serious Injury	4094	Gulf of St Lawrence, QC	EN	1	CN	PT	Line exiting right mouth, crossing over back, ending at buoys aft of flukes. Non-constricting configuration, but evidence of significant health decline. No resights.
07/19/2017	Mortality	2140	Gulf of St Lawrence, QC	VS	1	CN	-	Fresh carcass with acute internal hemorrhaging. Glucorticoid levels support acute blunt force trauma as COD.
08/06/2017	Mortality	-	Martha's Vineyard, MA	EN	1	XU	NP	No gear present, but evidence of constricting wraps around both pectorals and flukes with associated tissue reaction. Histopathology results support entanglement as COD.
09/15/2017	Mortality	4504	Gulf of St Lawrence, QC	EN	1	CN	PT	Anchored in gear with extensive constricting wraps with associated hemorrhaging.
10/23/2017	Mortality	-	Nashawena Island, MA	EN	1	XU	NP	No gear present, but evidence of extensive ent involving pectorals, mouth, and body. Hemorrhaging associated with body and right pectoral injuries. Histo results support entanglement as COD.
01/22/2018	Mortality	3893	55 nm E of Virginia Beach, VA	EN	1	CN	PT	Extensive, severe constricting entanglement including partial amputation of right pectoral accompanied by severe proliferative bone growth. COD - chronic entanglement.
02/15/2018	Serious Injury	3296	33 nm E of Jekyll Island, GA	EN	1	XU	NP	No gear present, but extensive recent injuries consistent with constricting gear on right flipper, peduncle, and leading fluke edges. Large portion of right lip missing. Extremely poor condition - emaciated with heavy cyamid load. No resights.

07/13/2018	Prorated Injury	3312	25.6 nm E of Miscou Island, NB	EN	0.75	CN	NR	Free swimming with line through mouth and trailing both sides. Full configuration unknown - unable to confirm extent of flipper involvement. No resights.
07/30/2018	Prorated Injury	3843	13 nm E of Grand Manan, NB	EN	0.75	XC	GU	Free-swimming with buoy trailing 70 ft behind whale. Attachment point(s) unknown. Severe, deep, raw injuries on peduncle & head. Partial disentanglement. Resighted with line exiting left mouth and no trailing gear. Possible rostrum and left pectoral wraps, but unable to confirm. Improved health, but final configuration unclear. No additional resights.
08/25/2018	Mortality	4505	Martha's Vineyard, MA	EN	1	XU	NP	No gear present. Evidence of constricting pectoral wraps with associated hemorrhaging. COD - acute entanglement
10/14/2018	Mortality	3515	134 nm E of Nantucket , MA	EN	1	XU	NP	No gear present, but evidence of constricting wraps across ventral surface and at pectorals. COD - acute, severe entanglement.
12/20/2018	Prorated Injury	2310	Nantucket , MA	EN	0.75	XU	NR	Free-swimming with open bridle through mouth. Resight in Apr2019 shows configuration changed, but unable to determine full configuration. Health appears stable.No additional resights
12/1/2018	Serious Injury	3208	South of Nantucket , MA	EN	1	XU	NP	No gear present. Evidence of new, healed, constricting body wrap. Health decline evident - grey, lesions, thin. Previously reported as 24Dec2018
6/4/2019	Mortality	4023	46.4 nm ESE of Perce, QC	VS	1	CN	-	Abrasion, blubber hemorrhage, and muscle contusion caudal to blowholes consistent with pre-mortem vessel strike
6/20/2019	Mortality	1281	27.3 nm E of Magdalen Islands, QC	VS	1	CN	-	Sharp trauma penetrating body cavity consistent with vessel strike. Vessel >65 ft based on laceration dimensions.
6/25/2019	Mortality	1514	20.3 nm E of Miscou Island, QC	VS	1	CN	-	Fractured ear bones, skull hemorrhaging, and jaw contusion consistent with blunt trauma from vessel strike.
6/27/2019	Mortality	3450	37.4 nm E of Perce, QC	VS	1	CN	-	Hemothorax consistent with blunt force trauma.
7/4/2019	Serious Injury	3125	35.2 nm E of Perce, QC	EN	1	CN	PT	Free-swimming with extensive entanglement involving embedded head wraps, flipper wraps, and trailing gear. Baleen damaged and protruding from mouth. Partially disentangled: 200-300 ft of line removed. Embedded rostrum and blowhole wraps remain, but now able to open mouth. Significant health decline. No resights.

8/6/2019	Mortality	1226	36.4 nm NW of Iles de la Madeleine, NS	EN	1	CN	NR	Constricting rostrum wraps, in anchored or weighted gear. Carcass found with no gear present but evidence of extensive constricting entanglement involving rostrum, gape, both flippers. COD -~~=~~ probable acute entanglement
1/8/2020	Serious Injury	2020 Calf of 2360	7 nm E of Altamaha Sound, GA	VS	1	US	-	Dependent calf with deep lacerations to head and lips, exposing bone. No resights post 15Jan2020.
2/24/2020	Serious Injury	3180	38.2 nm SE of Nantucket, MA	EN	1	XU	NR	Free-swimming with bullet buoy lodged in right mouthline, far forward. Line seen exiting left gape. No trailing gear visible. Poor condition - emaciated with heavy cyamid load. No resights.
3/16/2020	Prorated Injury	-	Georges Bank	EN	0.75	XU	NR	Free-swimming with 2 polyballs trailing approximately 30 ft aft of flukes. Attachment point(s) and full configuration unknown. No resights
6/24/2020	Mortality	5060 (2020 Calf of #3560)	0.5 nm off Elberon, NJ	VS	1	US	-	Dependent calf with deep lacerations along head and peduncle from 2 separate vessel strikes. Head lacerations were chronic and debilitating while the laceration to peduncle was acutely fatal. Proximate COD - sharp and blunt vessel trauma. Ultimate COD - hemorrhage and paralysis.
10/11/2020	Serious Injury	4680	2.7 nm E of Sea Bright, NJ	EN	1	XU	NR	Free-swimming with 2 lines embedded in rostrum, remaining configuration unknown. Extremely poor condition - emaciated with greying skin. Large, open lesion on left side of head. No resights.
10/19/2020	Mortality	3920	10.1 nm S of Nantucket, MA	EN	1	CN	PT	Free-swimming with deeply embedded rostrum wrap. Partial disentanglement - removed 100 ft of trailing line and attached telemetry. Health deteriorated over subsequent sightings - emaciation, increased cyamid load, sloughing skin. Carcass documented on 27Feb2021 off Florida. No necropsy conducted but COD from chronic entanglement most parsimonious.

Assigned Cause	**Five-year mean (US/CN/XU/XC)**
Vessel strike	2.4~~0~~ (0.8~~4~~/1.6/0/0)
Entanglement	5.7 (0/2.15~~1.95~~/2.65/0.9~~1.05~~)

a. For more details on events, ~~please~~ see Henry *et al.* ~~*in review*~~2022.
b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012).
d. CN=Canada, US=United States, XC=Unassigned 1st sight in CN, XU=Unassigned 1st sight in US.
e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir.

HABITAT ISSUES

Baumgartner *et al.* (2017) discussed that ongoing and future environmental and ecosystem changes may displace *C. finmarchicus*~~,~~ or disrupt the mechanisms that create very dense copepod patches upon which right whales depend. One of the consequences of this may be a shift of right whales into different areas with additional anthropogenic impacts to the species. Record *et al.* (2019) described the effects of a changing oceanographic climatology in the Gulf of Maine on the distribution of right whales and their prey. The warming conditions in the Gulf of Maine have altered the availability of late stage *C. finmarchicus* to right whales, resulting in a sharp decline in sightings in the Bay of

Fundy and Great South Channel over the last decade (Davies *et al.* 2019; Meyer-Gutbrod *et al.* 2021; Record *et al.* 2019)~~,~~ and an increase in sightings in Cape Cod Bay (Ganley *et al.* 2019). Gavrilchuk *et al.* (2021) suggested that ocean warming in the Gulf of St. Lawrence may eventually compromise the suitability of this foraging area for right whales, potentially displacing them further to the shelf waters east of Newfoundland and Labrador in search~~pursuit~~ of dense *Calanus* patches.

In addition,~~ construction noise and vessel traffic from planned development of~~ offshore wind energy development along the east coast of the U.S~~. in southern New England and the mid-Atlantic could result in communication masking, increased risk of vessel strike, or avoidance of wind energy areas.~~will introduce stressors to North Atlantic right whales and their habitat such as noise and/or pressure, entanglement hazards, vessel traffic, and changes in oceanographic conditions. Potential impacts to North Atlantic right whales, depending on the stressors, include: hearing impairment; behavioral disturbance; avoidance of wind areas; injury and mortality (i.e., from entanglement or vessel strike); and changes in quality and availability of prey that may lead to reduced fitness (decreased survival and reproduction) (Bailey *et al.* 2014; Barkaszi *et al.* 2021; Carpenter *et al.* 2016; Dorrell *et al.* 2022; Leiter *et al.* 2017; Maxwell *et al.* 2022; Quintana-Rizzo *et al.* 2021~~;Offshore wind turbines could also influence the hydrodynamics of seasonal stratification and ocean mixing, which, in turn, could influence shelf-wide primary production and copepod distribution (Broström 2008; Paskyabi and Fer 2012; Paskyabi 2015, ., Afsharian et al. 2020~~). While only a few projects in U.S. water are currently fully approved and under development, should the proposed development go forward as planned, the extensive overlap with their range would mean that in the future, any individual right whale may be exposed to multiple projects. Mitigation and monitoring have the potential to reduce the probability, magnitude, and severity of potential impacts.

STATUS OF STOCK

This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and also because the North Atlantic right whale is listed as an endangered species under the ESA. The size of this stock is considered to be extremely low relative to OSP~~ in the U.S. Atlantic EEZ. This species is listed as endangered under the ESA~~ and has been declining since 2011 (see Pace *et al.* 2017). The North Atlantic right whale is considered one of the most critically endangered populations of large whales in the world (Clapham *et al.* 1999; NMFS 2017; IUCN 2020). The observed (and clearly biased low) human-caused mortality and serious injury was 8.1~~7.7~~ right whales per year from 2016~~5~~ through 2020~~19~~. Using the refined methods of Pace *et al.* (2021), the estimated annual rate of total mortality for the period 2015~~4~~–2019~~8~~ was 31.2~~27.4~~, which is 4.1~~3.4~~ times larger than the 7.7~~8.15~~ total derived from reported mortality and serious injury for the same period. Given that PBR has been calculated as 0.7, human-caused mortality or serious injury for this stock must be considered significant. ~~This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and also because the North Atlantic right whale is an endangered species. All ESA-listed species are classified as strategic by definition; therefore, any uncertainties discussed above will not affect the status of stock.~~

REFERENCES CITED

Aguilar, A. 1986. A review of old Basque whaling and its effect on the right whales of the North Atlantic. Rep. Int. Whal. Comm. (Special Issue) 10:191–199.

Bailey, H., K.L. Brookes and P.M. Thompson. 2014. Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future. Aquat. Biosyst. 10.

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. 73pp.

Barzaski, M., M. Fonseca, T. Foster, A. Malhorta and K. Olsen. 2021. Rish assessment to model encounter rates between large whales and sea turtles and vessel traffic from offshore wind energy on the Atlantic OCS. Bureau of Ocean Management (BOEM). OCS Study. BOEM 2021-034. 85 pp.

Baumgartner, M.F. and B.R. Mate. 2005. Summer and fall habitat of North Atlantic right whales (*Eubalaena glacialis*) inferred from satellite telemetry. Can. J. Fish. Aq. Sci. 62:527–543.

Bort, J., S. Van Parijs, P. Stevick, E. Summers and S. Todd. 2015. North Atlantic right whale *Eubalaena glacialis* vocalization patterns in the central Gulf of Maine from October 2009 through October 2010. Endanger. Spec. Res. 26:271–280.

Brown, M.W. and M.K. Marx. 2000. Surveillance, monitoring and management of North Atlantic right whales, *Eubalaena glacialis*, in Cape Cod Bay, Massachusetts: January to mid-May, 2000. Final report. Division of Marine Fisheries, Boston, Massachusetts. 52pp. http://www.mass.gov/eea/docs/dfg/dmf/programsandprojects/rwhale00.pdf

Browning, C.L., R.M. Rolland and S.D. Kraus. 2010. Estimated calf and perinatal mortality in western North Atlantic right whales (*Eubalaena glacialis*). Mar. Mamm. Sci. 26:648–662.

Carpenter, J.R., L. Merckelbach, U. Callies, S. Clark, L. Gaslikova and B. Baschek. 2016. Potential impacts of offshore wind farms on North Sea stratification. PLoS One 11:e0160830.

Caswell, H., S. Brault and M. Fujiwara. 1999. Declining survival probability threatens the North Atlantic right whale. Proc. Natl. Acad. Sci. USA 96:3308–3313.

Christiansen, F., S.M. Dawson, J.W. Durban, H. Fearnbach, C.A. Miller, L. Bejder, M. Uhart, M. Sironi, P. Corkeron, W. Rayment, E. Leunissen, E. Haria, R. Ward, H.A. Warick, I. Kerr, M.S. Lynn, H.M. Pettis, and M. J. Moore. 2020. Population comparison of right whale body condition reveals poor state of the North Atlantic right whale. Mar. Ecol. Prog. Ser. 640:1–16.

Clapham, P.J. (ed). 2002. Report of the working group on survival estimation for North Atlantic right whales. Available from the Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543.

Cole, T.V.N., P. Hamilton, A.G. Henry, P. Duley, R.M. Pace III, B.N. White and T. Frasier. 2013. Evidence of a North Atlantic right whale *Eubalaena glacialis* mating ground. Endang. Species Res. 21:55–64.

Cole, T.V.N., P. Duley, M. Foster, A. Henry and D.D. Morin. 2016. 2015 Right Whale aerial surveys of the Scotian Shelf and Gulf of St. Lawrence. Northeast Fish. Sci. Cent. Ref. Doc. 16-02. 14pp.

Corkeron, P., P. Hamilton, J. Bannister, P. Best, C. Charlton, K.R. Groch, K. Findlay, V. Rowntree, E. Vermeulen and R.M. Pace. 2018. The recovery of North Atlantic right whales, *Eubalaena glacialis*, has been constrained by human-caused mortality. R. Soc. Open Sci. 5:180892.

Crowe, L.M., M.W. Brown, P.J. Corkeron, P.K. Hamilton, C. Ramp, S. Ratelle, A.S.M. Vanderlaan and T.V. N. Cole. 2021. In plane sight: A mark-recapture analysis of North Atlantic right whales in the Gulf of St. Lawrence. Endang. Species Res. 46:227–251.

Davies, K.T.A., M.W. Brown, P.K. Hamilton, A.R Knowlton, C.T. Taggart and A.S.M. Vanderlaan. 2019. Variation in North Atlantic right whale (*Eubalaena glacialis*) occurrence in the Bay of Fundy, Canada, over three decades. Endang. Species Res. 39:159–171.

Davis, G.E., M.F. Baumgartner, J.M. Bonnell, J. Bell, C. Berchok, J.B. Thornton, S. Brault, G. Buchanan, R.A. Charif, D. Cholewiak, C.W. Clark, P. Corkeron, J. Delarue, K. Dudzinski, L. Hatch, J. Hildebrand, L. Hodge, H. Klinck, S. Kraus, B. Martin, D.K. Mellinger, H. Moors-Murphy, S. Nieukirk, D.P. Nowacek, S. Parks, A.J. Read, A.N. Rice, D. Risch, A. Širović, M. Soldevilla, K. Stafford, J.E. Stanistreet, E. Summers, S. Todd, A. Warde and S.M. Van Parijs. 2017. Long-term passive acoustic recordings track the changing distribution of North Atlantic right whales (*Eubalaena glacialis*) from 2004 to 2014. Sci. Rep. 7:13460.

Daoust, P.-Y., E.L. Couture, T. Wimmer and L. Bourque. 2017. Incident Report: North Atlantic right whale mortality event in the Gulf of St. Lawrence, 2017. Collaborative report produced *by:* Canadian Wildlife Health Cooperative, Marine Animal Response Society, and Fisheries and Oceans Canada. 256pp.

DFO [Department of Fisheries and Oceans Canada]. 2020. Updated information on the distribution of North Atlantic right whale in Canadian waters. DFO Can Sci Advis Sec Sci Advis Rep 2020/037.

Dorrell, R.M., C.J. Lloyd, B.J. Lincoln, T.P. Rippeth, J.R. Taylor, C.P. Caulfield, J. Sharples, J.A. Polton, B.D. Scannell, D.M. Greaves, et al. 2022. Anthropogenic mixing in seasonally stratified shelf seas by offshore wind farm infrastructure. Front. Mar. Sci. 9:830927.

Fitzgerald, Kayla. 2018. Combining genetic and photo-identification data to improve abundance estimates for the North Atlantic right whale. Master's Thesis. Saint Mary's University, Halifax, Nova Scotia. 32pp.

Fortune, S.M.E., A.W. Trites, C.A. Mayo, D.A.S. Rosen and P.K. Hamilton. 2013. Energetic requirements of North Atlantic right whales and the implications for species recovery. Mar. Ecol. Prog. Ser. 478:253–272.

Frasier, T.R., B.A. McLeod, R.M. Gillett, M.W. Brown and B.N. White. 2007a. Right whales past and present as revealed by their genes. Pages 200–231 *in*: S.D. Kraus and R.M. Rolland (eds). The urban whale: North Atlantic right whales at the crossroads. Harvard University Press, Cambridge, Massachusetts.

Frasier, T.R., P.K. Hamilton, M.W. Brown, L.A. Conger, A.R. Knowlton, M.K. Marx, C.K. Slay, S.D. Kraus and B.N. White. 2007b. Patterns of male reproductive success in a highly promiscuous whale species: The endangered North Atlantic right whale. Mol. Ecol. 16:5277–5293.

S.D. Kraus, T.R. Frasier, P.K. Hamilton, M.W. Brown, S.D. Kraus and B.N. White. 2009. Sources and rates of errors in methods of individual identification for North Atlantic right whales. J. Mamm. 90(5):1246–1255.

Ganley, L.C., S. Brault and C.A. Mayo. 2019 What we see is not what there is: Estimating North Atlantic right whale *Eubalaena glacialis* local abundance. Endang. Species Res. 38:101–113.

Gavrilchuk, K., V. Lesage, S.M.E. Fortune, A.W. Trites and S. Plourde S. 2021. Foraging habitat of North Atlantic right whales has declined in the Gulf of St. Lawrence, Canada, and may be insufficient for successful reproduction. Endang. Species Res. 44:113–136.

Hain, J.H.W. 1975. The international regulation of whaling. Marine Affairs J. 3:28–48.

Hamilton, P.K., A.R. Knowlton and M.K. Marx. 2007. Right whales tell their own stories: The photo-identification catalog. Pages 75–104 *in*: S.D. Kraus and R.M. Rolland (eds). The urban whale: North Atlantic right whales at the crossroads. Harvard University Press, Cambridge, Massachusetts.

Hamilton, P.K., A.R. Knowlton, M.K. Marx and S.D. Kraus. 1998. Age structure and longevity in North Atlantic right whales *Eubalaena glacialis* and their relation to reproduction. Mar. Ecol. Prog. Ser. 171:285–292.

Hamilton, P.K., A.R. Knowlton, M.N. Hagbloom, K.R. Howe, M.K. Marx, H.M. Pettis, A.M. Warren and M.A. Zani. 2020. Maintenance of the North Atlantic right whale catalog, whale scarring and visual health databases, anthropogenic injury case studies, and near real-time matching for biopsy efforts, entangled, injured, sick, or dead right whales. Contract report no. 1305M2-18-P-NFFM-0108 to the NMFS Northeast Fisheries Science Center. Anderson Cabot Center for Ocean Life, New England Aquarium, Boston, MA.

Hamilton, P.K., B.A. Frasier, L.A. Conger, R.C. George, K.A. Jackson and T.R. Frasier. 2022. Genetic identifications challenge our assumptions of physical development and mother–calf associations and separation times: a case study of the North Atlantic right whale (*Eubalaena glacialis*). Mamm. Biol. https://doi.org/10.1007/s42991-021-00177-4.

Hayes, S.A., S. Gardner, L. Garrison, A. Henry and L. Leandro. 2018. North Atlantic Right Whales – Evaluating their recovery challenges in 2018. NOAA Tech Memo NMFS-NE 247. 24p.

Henry, A.G., M. Garron~~T.V.N. Cole~~, D. Morin, A. Smith, A. Reid, ~~L. Hall,~~ W. Ledwell and ~~D. Morin and A. Reid~~ T.V.N. Cole. 2022~~*in review*~~. Mortality and serious injury determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2015–2019. NOAA Tech Memo NMFS-NE 280. 60pp.~~Northeast Fish. Sci. Cent. Ref. Doc.~~

Hodge, K., C. Muirhead, J. Morano, C. Clark and A. Rice. 2015. North Atlantic right whale occurrence near wind energy areas along the mid-Atlantic US coast: Implications for management. Endang. Species Res. 28:225–234.

IUCN [International Union for Conservation of Nature]. 2020. Almost a third of lemurs and North Atlantic right whale now critically endangered – IUCN Red List. International Union for Conservation of Nature, Gland, Switzerland. https://www.iucn.org/news/species/202007/almost-a-third-lemurs-and-north-atlantic-right-whale-now-critically-endangered-iucn-red-list

IWC [International Whaling Commission]. 2001. Report of the workshop on the comprehensive assessment of right whales: A worldwide comparison. J. Cetacean Res. Manage. (Special Issue) 2:1–60.

Jacobsen, K., M. Marx and N. Øien. 2004. Two-way trans-Atlantic migration of a North Atlantic right whale (*Eubalaena glacialis*). Mar. Mamm. Sci. 20:161–166.

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry and P. Clapham. 2005. Fishing gear involved in entanglements of right and humpback whales. Mar. Mamm. Sci. 21:635–645.

Kenney, R.D. 2018. What if there were no fishing? North Atlantic right whale population trajectories without entanglement mortality. Endanger. Species Res. 37:233–237.

Kenney, R.D., M.A.M. Hyman, R.E. Owen, G.P. Scott and H.E. Winn. 1986. Estimation of prey densities required by western North Atlantic right whales. Mar. Mamm. Sci. 2:1–13.

Kenney, R.D., H.E. Winn and M.C. Macaulay. 1995. Cetaceans in the Great South Channel, 1979–1989: Right whale (*Eubalaena glacialis*). Cont. Shelf Res. 15:385–414.

Knowlton, A.R. and S.D. Kraus. 2001. Mortality and serious injury of North Atlantic right whales (*Eubalaena glacialis*) in the North Atlantic Ocean. J. Cetacean Res. Manage. (Special Issue) 2:193–208.

Knowlton, A.R., S.D. Kraus and R.D. Kenney. 1994. Reproduction in North Atlantic right whales (*Eubalaena glacialis*). Can. J. Zool. 72:1297–1305.

Knowlton, A.R., J. Sigurjonsson, J.N. Ciano and S.D. Kraus. 1992. Long-distance movements of North Atlantic right whales (*Eubalaena glacialis*). Mar. Mamm. Sci. 8:397–405.

Knowlton, A.R., P.K. Hamilton, M.K. Marx, H.M. Pettis and S.D. Kraus. 2012. Monitoring North Atlantic right whale *Eubalaena glacialis* entanglement rates: A 30 year retrospective. Mar. Ecol. Prog. Ser. 466:293–302.

Knowlton, A.R., J. Robbins, S. Landry, H.A. McKenna, S.D. Kraus and T.B. Werner. 2016. Effects of fishing rope strength on the severity of large whale entanglements. Conserv. Biol. 30:318–328. DOI: 10.1111/cobi.12590

Kraus, S.D. 1990. Rates and potential causes of mortality in North Atlantic right whales (*Eubalaena glacialis*). Mar. Mamm. Sci. 6:278–291.

Laist, D.W., A.R. Knowlton and D. Pendleton. 2014. Effectiveness of mandatory vessel speed limits for protecting North Atlantic Right Whales. Endang. Species Res. 23:133–147.

Leiter, S.M, K.M. Stone, J.L. Thompson, C.M. Accardo, B.C. Wikgren, M.A. Zani, T.V.N. Cole, R.D. Kenney, C.A. Mayo and S.D. Kraus. 2017. North Atlantic right whale *Eubalaena glacialis* occurrence in offshore wind energy areas near Massachusetts and Rhode Island, USA. Endang. Species Res. 34:45–59.

Malik, S., M.W. Brown, S.D. Kraus, A. Knowlton, P. Hamilton and B.N. White. 1999. Assessment of genetic structuring and habitat philopatry in the North Atlantic right whale (*Eubalaena glacialis*). Can. J. Zool. 77:1217–1222.

Malik, S., M.W. Brown, S.D. Kraus and B.N. White. 2000. Analysis of mitochondrial DNA diversity within and between North and South Atlantic right whales. Mar. Mamm. Sci. 16:545–558.

Mate, B.M., S.L. Nieukirk and S.D. Kraus. 1997. Satellite-monitored movements of the northern right whale. J. Wildl. Manage. 61:1393–1405.

Maxwell, S.M., F. Kershaw, C. C. Locke, M. G. Conners, C. Dawson, S. Aylesworth, R. Loomis, and A.F. Johnson. 2022. Potential impacts of floating wind turbine technology for marine species and habitats. J. of Env. Manag. 307:114577.

Mayo, C.A. and M.K. Marx. 1990. Surface foraging behaviour of the North Atlantic right whale, *Eubalaena glacialis*, and associated zooplankton characteristics. Can. J. Zool. 68:2214–2220.

Mayo, C.A., L. Ganley, C.A. Hudak, S. Brault, M.K. Marx, E. Burke and M.W. Brown. 2018. Distribution, demography, and behavior of North Atlantic right whales (*Eubalaena glacialis*) in Cape Cod Bay, Massachusetts, 1998–2013. Mar. Mam. Sci. 34(4):979–996.

McLeod, B., M. Brown, M. Moore, W. Stevens, S. H. Barkham, M. Barkham and B. White. 2008. Bowhead whales, and not right whales, were the primary target of 16th- to 17th-century Basque whalers in the western North Atlantic. Arctic. 61:61–75.

McLeod, B.A. and B.N. White. 2010. Tracking mtDNA heteroplasmy through multiple generations in the North Atlantic right whale (*Eubalaena glacialis*). J. Hered. 101:235–239.

Mellinger, D.K, S.L. Nieukirk, K. Klink, H. Klink, R.P. Dziak, P.J. Clapham and B Brandsdóttir. 2011. Confirmation of right whales near a nineteenth-century whaling ground east of southern Greenland. Biol. Lettr. 7:411–413.

Meyer-Gutbrod, E.L. and C.H. Greene. 2014. Climate-associated regime shifts drive decadal scale variability in recovery of North Atlantic right whale population. Oceanography 27(3):148–153.

Meyer-Gutbrod, E.L., C.H. Greene, K.T.A. Davies and D.G. Johns. 2021. Ocean Regime Shift is Driving Collapse of the North Atlantic Right Whale Population. Oceanography. 34. 22–31.

Miller, C., D. Reeb, P. Best, A. Knowlton, M. Brown and M. Moore. 2011. Blubber thickness in right whales *Eubalaena glacialis* and *Eubalaena australis* related with reproduction, life history status and prey abundance. Mar. Ecol. Prog. Ser. 438:267–283.

Monserrat, S., M.G. Pennino, T.D. Smith, R.R. Reeves, C.N. Meynard, D.M. Kaplan and A.S.L. Rodrigues. 2015 A spatially explicit estimate of the prewhaling abundance of the endangered North Atlantic right whale. Cons. Biol. 30:783–791.

Moore, J.C. and E. Clark. 1963. Discovery of right whales in the Gulf of Mexico. Science. 141:269.

Moore, M.J., A.R. Knowlton, S.D. Kraus, W.A. Mc Lellan and R.K. Bonde. 2005. Morphometry, gross morphology and available histopathology in North Atlantic right whale (*Eubalaena glacialis*) mortalities. J. Cetacean Res. Manage. 6:199–214.

Moore, M. J., G.H. Mitchell, T.K. Rowles and G. Early. 2020. Dead cetacean? Beach, bloat, float, sink. Front. Mar. Sci. 7:333.

Morano, J.L., A.N. Rice, J.T. Tielens, B.J. Estabrook, A. Murray, B.L. Roberts and C.W. Clark. 2012. Acoustically detected year-round presence of right whales in an urbanized migration corridor. Conserv. Biol. 26:698–707.

NMFS [National Marine Fisheries Service]. 2015. Critical Habitat for Endangered North Atlantic right whale. Federal Register. 80:9314–9345.

NMFS [National Marine Fisheries Service]. 2017. North Atlantic right whale (*Eubalaena glacialis*) 5-year review: Summary and evaluation. NMFS Greater Atlantic Regional Fisheries Office, Gloucester, Massachusetts. 34pp. https://www.greateratlantic.fisheries.noaa.gov/protected/final_narw_5-year_review_2017.pdf

NMFS [National Marine Fisheries Service]. 2020. North Atlantic right whale (Eubalaena glacialis) vessel speed rule assessment. NMFS Office of Protected Resources, Silver Spring, MD. 53pp. https://media.fisheries.noaa.gov/2021-01/FINAL_NARW_Vessel_Speed_Rule_Report_Jun_2020.pdf.

Pace, R.M. 2021. Revisions and further evaluations of the right whale abundance model: Improvements for hypothesis testing. NOAA Tech Memo NMFS-NE 269. 54pp.

Pace, R.M., III, T.V.N. Cole and A.G. Henry. 2015. Incremental fishing gear modifications fail to significantly reduce large whale serious injury rates. Endang. Species. Res. 26:115–126.

Pace, R.M., III, P.J. Corkeron and S.D. Kraus. 2017. State-space mark-recapture estimates reveal a recent decline in abundance of North Atlantic right whales. Ecol. and Evol. 7:8730–8741. DOI: 10.1002/ece3.3406

Pace, RM, III, R. Williams, S.D. Kraus, A.R. Knowlton and H.M. Pettis. 2021. Cryptic mortality of North Atlantic right whales. Conservation Science and Practice. https://doi.org/10.1111/csp2.346

Patrician, M.R., I.S. Biedron, H.C. Esch, F.W. Wenzel, L.A. Cooper, P.K. Hamilton, A.H. Glass and M.F. Baumgartner. 2009. Evidence of a North Atlantic right whale calf (*Eubalaena glacialis*) born in northeastern U.S. waters. Mar. Mamm. Sci. 25:462–477.

Pettis, H.M., R.M. Rolland, P.K. Hamilton, A.R. Knowlton, E.A. Burgess and S.D. Kraus. 2017. Body condition changes arising from natural factors and fishing gear entanglements in North Atlantic right whales *Eubalaena glacialis*. Endang. Species Res. 32:237–249.

Pettis, H.M., R.M. Pace and P.K. Hamilton P.K. 2021. North Atlantic Right Whale Consortium: 2020 annual report card. Report to the North Atlantic Right Whale Consortium. www.narwc.org

Quintana-Rizzo, E., S. Leiter, T.V.N. Cole, M.N. Hagbloom, A.R. Knowlton, P. Nagelkirk, O. O'Brien, C.B. Khan, A.G. Henry, P.A. Duley, L.M. Crowe, C.A. Mayo and S.D. Kraus. 2021. Residency, demographics, and movement patterns of North Atlantic right whales (*Eubalaena glacialis*) in an offshore wind energy development area in southern New England, USA. Endang. Species Res. 45:251–268.

Rastogi, T., M.W. Brown, B.A. McLeod, T.R. Frasier, R. Grenier, S.L. Cumbaa, J. Nadarajah and B.N. White. 2004. Genetic analysis of 16th-century whale bones prompts a revision of the impact of Basque whaling on right and bowhead whales in the western North Atlantic. Can. J. Zool. 82:1647–1654.

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Gillnets and cetaceans. Rep. Int. Whal. Comm. (Special Issue) 15:133–147.

Record, N.R., J.A. Runge, D.E. Pendleton, W.M. Balch, K.T.A. Davies, A.J. Pershing, C.L. Johnson, K. Stamieszkin, R. Ji, Z. Feng, S.D. Kraus, R.D. Kenney, C.A. Hudak, C.A. Mayo, C. Chen, J.E. Salisbury and C.R.S. Thompson. 2019. Rapid climate-driven circulation changes threaten conservation of endangered North Atlantic right whales. Oceanography. 32(2):162–169. https://doi.org/ 10.5670/oceanog.2019.201

Reeves, R.R., J.M. Breiwick and E. Mitchell. 1992. Pre-exploitation abundance of right whales off the eastern United States. Pages 5-7 *in*: J. Hain (ed) The right whale in the western North Atlantic: A science and management workshop, 14–15 April 1992, Silver Spring, Maryland. Northeast Fish. Sci. Cent. Ref. Doc. 92-05.

Reeves, R.R., R. Rolland and P. Clapham (eds). 2001. Report of the workshop on the causes of reproductive failure in North Atlantic right whales: New avenues of research. Northeast Fish. Sci. Cent. Ref. Doc. 01-16. 46pp.

Reeves, R.R., T. Smith and E. Josephson. 2007. Near-annihilation of a species: Right whaling in the North Atlantic. Pages 39–74 *in*: S.D. Kraus and R. M. Rolland (eds). The urban whale: North Atlantic right whales at the crossroads. Harvard University Press, Cambridge, MA.

Rolland, R.M., R.S. Schick, H.M. Pettis, A.R. Knowlton, P.K. Hamilton, J.S. Clark and S.D. Krauss. 2016. Health of North Atlantic right whales *Eubalaena glacialis* over three decades: From individual health to demographic and population health trends. Mar. Ecol. Prog. Series. 542:265–282.

Rosenbaum, H.C., M.S. Egan, P.J. Clapham, R.L. Brownell, Jr. and R. DeSalle. 1997. An effective method for isolating DNA from non-conventional museum specimens. Mol. Ecol. 6:677–681.

Rosenbaum, H.C., M.S. Egan, P.J. Clapham, R.L. Brownell, Jr., S. Malik, M.W. Brown, B.N. White, P. Walsh and R. DeSalle. 2000. Utility of North Atlantic right whale museum specimens for assessing changes in genetic diversity. Conserv. Biol. 14:1837–1842.

Salisbury, D., C.W. Clark and A.N. Rice. 2016. Right whale occurrence in Virginia coastal waters: Implications of endangered species presence in a rapidly developing energy market. Mar. Mamm. Sci. 32:508–519. DOI: 10.1111/mms.12276

Schaeff, C.M., S.D. Kraus, M.W. Brown, J. Perkins, R. Payne and B.N. White. 1997. Comparison of genetic variability of North and South Atlantic right whales (*Eubalaena*) using DNA fingerprinting. Can. J. Zool. 75:1073–1080.

Schmidly, D.J., C.O. Martin and G.F. Collins. 1972. First occurrence of a black right whale (*Balaena glacialis*) along the Texas coast. Southw. Nat. 17:214–215.

Sharp, S.M., W.A. McLellan, D.S. Rotstein, A.M Costidis, S.G. Barco, K. Durham, T.D. Pitchford, K.A. Jackson, P.-Y. Daoust, T. Wimmer, E.L. Couture, L. Bourque, T. Frasier, D. Fauquier, T.K. Rowles, P.K. Hamilton, H. Pettis and M.J. Moore. 2019. Gross and histopathologic diagnoses from North Atlantic right whale *Eubalaena glacialis* mortalities between 2003 and 2018. Dis. Aquat. Org. 135(1):1–31.

Silber, G. K. and S. Bettridge. 2012. An assessment of the final rule to implement vessel speed restrictions to reduce the threat of vessel collisions with North Atlantic right whales. NOAA Tech. Memo. NMFS-OPR-48. 114pp.

Silva, M.A., L. Steiner, I. Cascão, M.J. Cruz, R. Prieto, T. Cole, P.K. Hamilton and M.F. Baumgartner. 2012. Winter sighting of a known western North Atlantic right whale in the Azores. J. Cetacean Res. Manage. 12:65–69.

Simard, Y., N. Roy, S. Giard and F. Aulanier. 2019. North Atlantic right whale shift to the Gulf of St. Lawrence in 2015, revealed by long-term passive acoustics. Endang. Species Res. 40:271–284.

Stöber, U. and F. Thomsen 2021 How could operational underwater sound from future offshore wind turbines impact marine life? J. Acoust. Soc. Am. 149 (3).

Stewart, J.D., J.W. Durban, A.R. Knowlton, M.S. Lynn, H. Fearnbach, J. Barbaro, W.L. Perryman, C.A. Miller and M.J. Moore. 2021. Decreasing body lengths in North Atlantic right whales. Curr Biol 31:3174–3179.

Stone, K.M., S.M. Leiter, R.D. Kenney, B.C. Wikgren, J.L. Thompson, J.K.D. Taylor and S.D. Kraus. 2017. Distribution and abundance of cetaceans in a wind energy development area offshore of Massachusetts and Rhode Island. J. Coast. Conserv. 21:527–543.

van der Hoop, J.M., M.J. Moore, S.G. Barco, T.V. Cole, P.Y. Daoust, A.G. Henry, D.F. McAlpine, W.A. McLellan, T. Wimmer and A.R. Solow. 2013. Assessment of management to mitigate anthropogenic effects on large whales. Conserv. Biol. 27:121–133.

van der Hoop, J.M., A.S.M. Vanderlaan, T.V.N. Cole, A.G. Henry, L. Hall, B. Mase-Guthrie, T. Wimmer and M.J. Moore. 2015. Vessel strikes to large whales before and after the 2008 Ship Strike Rule. Conserv. Lett. 8:24–32.

van der Hoop, J.M., P. Corkeron and M.J. Moore. 2017. Entanglement is a costly life-history stage in large whales. Ecol. and Evol. 7:92–106. DOI: 10.1002/ece3.2615

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. 93pp. https://repository.library.noaa.gov/view/noaa/15963

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015 Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31:355–368.

Waldick, R.C., S.D. Kraus, M. Brown and B.N. White. 2002. Evaluating the effects of historic bottleneck events: An assessment of microsatellite variability in the endangered North Atlantic right whale. Mol. Ecol. 11:2241–2250.

Ward-Geiger, L.I., A.R. Knowlton, A.F. Amos, T.D. Pitchford, B. Mase-Guthrie and B.J. Zoodsma. 2011. Recent sightings of the North Atlantic right whale in the Gulf of Mexico. Gulf Mex. Sci. 29:74–78.

Whitt, A.D., K. Dudzinski and J.R. Laliberté. 2013. North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey, USA, and implications for management. Endanger. Species Res. 20:59–69.

Williams, R., S. Gero, L. Bejder, J. Calambokidis, S.D. Kraus, D. Lusseau, A.J. Read and J. Robbins. 2011. Underestimating the damage: Interpreting cetacean carcass recoveries in the context of the *Deepwater Horizon*/BP incident. Conserv. Lett. 4:228–233.

Williams, B.K., J.D. Nichols and M.J. Conroy. 2002. Analysis of Animal Populations, Modeling, Estimation and Decision Making. Academic Press. San Diego, California.

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~~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).~~

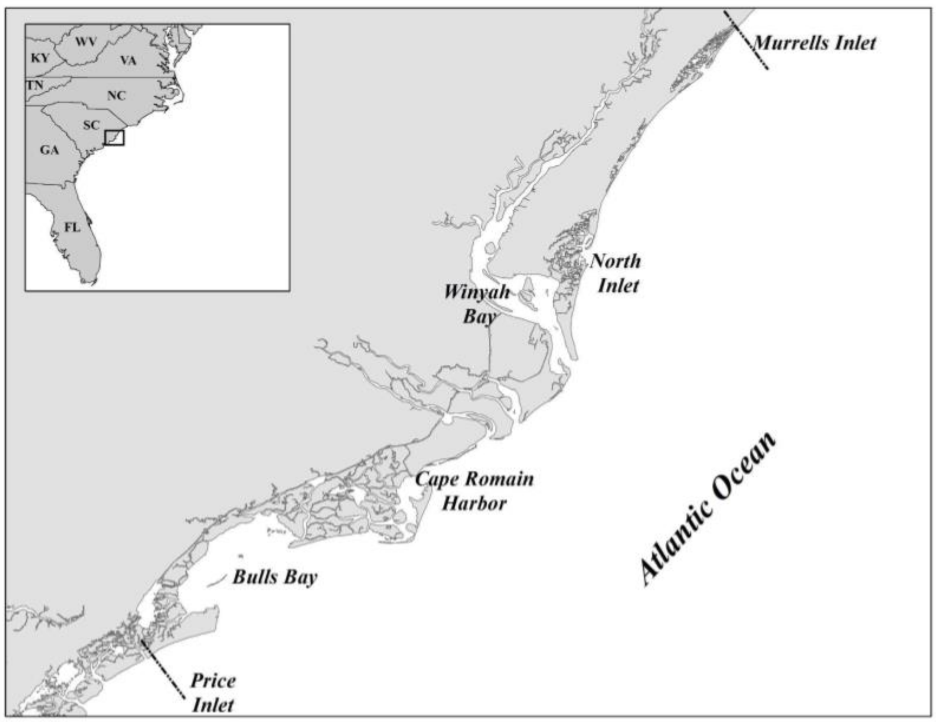


Figure 1. ***Geographic extent of the Northern South Carolina Estuarine System (NSCES) Stock. Dashed lines denote the boundaries.***

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~~between~~ 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, ~~T~~twenty-two (18%) year-round residents (sighted 4–20 times and in all ~~4~~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~~3~~ temperature classes in the same year), and 50 (41%) transients were identified. Sloan (2006) noted that three~~3~~ 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~~3~~ years and two~~2~~ individuals sighted over four~~4~~ 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~~2~~) conducted photo-ID surveys in Winyah Bay and North Inlet, South Carolina, ~~to the north of Cape Romain,~~ to examine distribution and home ranges of common bottlenose dolphins. During May 2011–~~—~~February 2012, Brusa *et al.* (2016~~2~~) identified 84 dolphins sighted three~~3~~ or more times on non-consecutive days, with 71 of those sighted during the warm season (May–~~-~~October), two~~2~~ 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~~3~~ 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).~~The total number of common bottlenose dolphins residing within the NSCES is unknown. Based on photo-ID data from April-September 2002, July-August 2003, and September 2003-August 2005, 121 individually identified dolphins were observed in the Cape Romain National Wildlife Refuge, and some were identified as year-round residents (Sloan 2006).~~

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).~~Present data are insufficient to calculate a minimum~~

~~population estimate for the NSCES Stock of common bottlenose dolphins.~~

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. ~~No abundance estimate is available for this stock, and therefore there are insufficient data to assess population trends.~~

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~~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. PBR ~~is unknown~~ 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~~2009-2013~~ 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).

~~because this stock is known to interact with unobserved fisheries (see below). The mean annual fishery-related mortality and serious injury for strandings identified as fishery-caused was 0.2. No additional mortality or serious injury was documented from other human-caused actions. The minimum total mean annual human-caused mortality and serious injury for this stock during 2009-2013 was 0.2.~~

Fishery Information

There are two commercial fisheries that interact, or that potentially could interact, with this stock. These include ~~are~~ the Category II Southeast Atlantic inshore gillnet fishery and the Atlantic blue crab trap/pot fishery. Detailed fishery information is presented in Appendix III. ~~(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.~~During 2009-2013, 1 mortality occurred in 2011 due to an interaction with the Southeast Atlantic inshore gillnet fishery. This mortality was included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, 11 June 2014).~~ It should be noted that there is no ~~systematic~~ observer program for this fishery, so it is not possible to estimate the total number of interactions or mortalities associated with gillnets.

~~Atlantic Blue Crab~~ 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 in prep). 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 in prep). 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 in prep) 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). ~~One of the largest commercial fisheries in South Carolina's coastal waters is the Atlantic blue crab (Callinectes sapidus) trap/pot 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.~~

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.~~During 2009-2013 there were no documented interactions with crab trap/pot gear in the NSCES area. It should be noted that there is no systematic observer program for the blue crab fishery.~~

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 in prep). 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 in prep).

Strandings

~~From 2009 to 2013, 11 stranded common bottlenose dolphins were reported within the NSCES area, including the 1 above mentioned fisheries interaction with gillnet gear (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, 11 June 2014). Of the 10 remaining strandings, for 2 dolphins, there was no evidence of human interaction, and for 8 dolphins, it could not be determined if there was evidence of human interaction.~~ 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 ~~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; 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. ~~An Unusual Mortality Event (UME)~~ 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).~~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, 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 and work continues to determine the effect of this event on all bottlenose dolphin stocks in the Atlantic.~~

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 the NSCES Stock is not a strategic stock under the MMPA. ~~However, because the abundance of the NSCES 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 Marine Mammal Protection Act.~~ The documented mean annual human-caused mortality for this stock for 2016–2020 was 0.5~~2009 – 2013 is 0.2~~. 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). 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. ~~However, there are commercial fisheries, including crab trap/pot fisheries, operating within this stock's boundaries and these fisheries have little to no observer coverage. The impact of crab trap/pot fisheries on estuarine bottlenose dolphins is currently unknown, but has been shown previously to be considerable in the similar Charleston Estuarine System Stock area (Burdett and McFee 2004). Therefore, the documented mortality must be considered a minimum estimate 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 in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this stock.~~

REFERENCES

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: 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.

Brusa, J.L., R.F. Young and T. Swanson. 2016. Abundance, ranging patterns, and social behavior of bottlenose dolphins (*Tursiops truncatus*) in an estuarine terminus. Aquat. Mamm. 42(1):109–121.~~Brusa, J.L. 2012. Distribution and social structure of an estuarine bottlenose dolphin (*Tursiops truncatus*) population in northern South Carolina. M.S. thesis from Coastal Carolina University. 89 pp.~~

~~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 categorization. J. Cetacean Res. Manage. 6(3): 231–240.~~

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112:1–23.

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

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

Dame, R., M. Alber, D. Allen, M. Mallin, C. Montague, A. Lewitus, A. Chalmers, A. Gardner, R. Gilman, C. Kjerfve, J. Pinckney, and N. Smith. 2000. Estuaries of the South Atlantic coast of North America: Their geographical signatures. Estuaries 23(6):793–819.

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

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.

Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1):107–117.

Maze-Foley, K. and L.P. Garrison. in prep. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2022-XX. XX pp.

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

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

Morris, S.E., J.L. Zelner, D.A. Fauquier, T.K. Rowles, P.E. Rosel, F. Gulland and B.T. Grenfell. 2015. Partially observed epidemics in wildlife hosts: Modelling an outbreak of dolphin morbillivirus in the northwestern Atlantic, June 2013–2014. J. R. Soc. Interface 12:20150676.

NMFS 2012. Process for distinguishing serious from non-serious injury of marine mammals: Process for injury determinations. National Marine Fisheries Service Policy Directive PD 02-038-01. January 2012. Available from: http://www.nmfs.noaa.gov/pr/laws/mmpa/policies.htm [Federal Register Notice, Vol. 77, No. 14, page 3233, January 23, 2012]

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available at: http://www.nmfs.noaa.gov/op/pds/index.html

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18:278–290.

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

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Molec. Ecol. 18:5030–5045.

Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded common bottlenose dolphins in southeastern Louisiana after the Deepwater Horizon oil spill. Endang. Species Res. 33:221–234.

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. Conserv. Genet. 6(5):715–728.

Silva, D., B. Tramutolo, E. DeSalvio, T. Speakman and R. Young. 2019. Abundance and movements of the Northern South Carolina Estuarine System Stock of bottlenose dolphins (*Tursiops truncatus*) (USA). JMATE 11(1):8–18.

Sloan, P.E. 2006. Residency patterns, seasonality and habitat use among bottlenose dolphins, *Tursiops truncatus*, in the Cape Romain National Wildlife Refuge, S.C. M.S. thesis from University of North Carolina Wilmington. 75 pp.

Urian, K.W., A.A. Hohn and L.J. Hansen. 1999. Status of the photo-identification catalog of coastal bottlenose dolphins of the western North Atlantic. Report of a workshop of catalog contributors. NOAA Tech. Memo. NMFS-SEFSC-425, Miami, FL. 22 pp.

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

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1):355–368.

Wells, R.S., M.D. Scott and A.B. Irvine. 1987. The social structure of free ranging bottlenose dolphins. pp. 247-305 *In:* H. Genoways (ed.) Current mammalogy, Volume 1. Plenum Press, New York, NY. 519 pp.

Young, R.F. and H.D. Phillips. 2002. Primary production required to support bottlenose dolphins in a salt marsh estuarine 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(4):879–892.

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 inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002a; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; 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). ~~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).~~

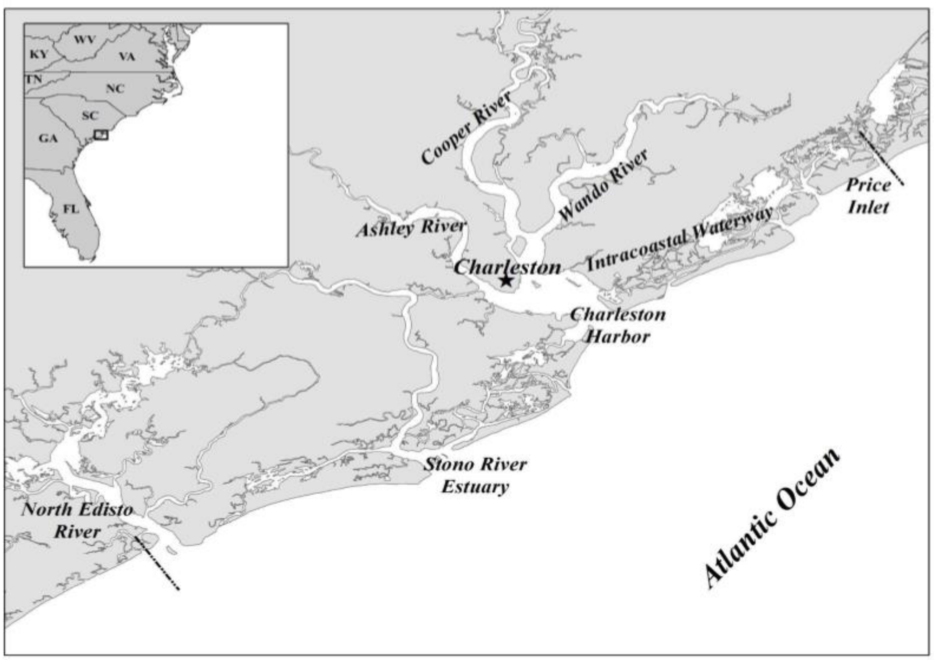


Figure 1. ***Geographic extent of the Charleston Estuarine System (CES) stock. Dashed lines denote the boundaries.***

The estuarine habitat within and around the Charleston, South Carolina, area comprises 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 the photo-ID findings of Zolman (2002). ~~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~~ and illustrated the limited range of these dolphins between adjacent estuarine areas and the connective nature of the areas within the Charleston region (Speakman *et al.* 2006~~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 (Speakman *et al.* 2006~~NOAA/NOS/NCCOS unpublished data~~), ~~. Again these data~~ underscoring the resident nature of dolphins in this region. Finally, three adult males resident to the Stono River Estuary and Charleston Harbor areas (based on long-term sighting histories) were fitted with satellite transmitters within the Stono River Estuary in 2013, and telemetry results demonstrated use of nearshore coastal waters by these residents (Balmer *et al.* 2021).

Speakman *et al.* (2006) summarized photo-ID studies carried out from 1994 to ~~–~~2003 on common bottlenose dolphins throughout the Charleston ~~e~~Estuarine ~~s~~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 five~~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 within the CES and 97% of the dolphins had high sighting frequencies in at least two areas, supporting the inclusion of the entire area as a single stock (Speakman *et al.* 2006). ~~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 two2 other areas and 8% were seen in three3 additional areas. This finding, that 97% of the dolphins with high sighting frequencies were observed in at least two2 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 nine9 times greater than in the ICW, illustrating that~~ Charleston Harbor ~~is~~was identified as 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.~~ Most~~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 (Figure 1). 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 20 km 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. There are insufficient data to determine whether multiple demographically-independent stocks exist within the CES area as there have been no directed studies to address this question; however, photo-ID data indicate movement of individual dolphins throughout the region (Speakman *et al.* 2006).

POPULATION SIZE

The total number of common bottlenose dolphins residing within the CES Stock is unknown because previous estimates are ~~greater~~more than 8 years old (Table 1; NMFS 2016). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates greater than 8 years old are deemed unreliable.~~

Earlier abundance estimates (>8 years old)

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

No current information on abundance is available to calculate a minimum population estimate for the CES Stock of common bottlenose dolphins. ~~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. PBR for the CES Stock of common bottlenose dolphins is undetermined (Table 1).

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

Nest	CV Nest	Nmin	Fr	Rmax	PBR
Unknown	-	Unknown	0.5	0.04	Undetermined

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the CES Stock during 2016–2020~~2009–2013~~ 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 1.8. Additional mean annual mortality and serious injury during 2016–2020 due to other human-caused sources was 0.4 (entanglement in unidentified gear and vessel strike). The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 2.2 (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 the only data 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) and not every recovered carcass with evidence of entanglement can be assigned to a fishery, 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). ~~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.~~ There are two commercial fisheries that interact, or potentially interact, with this stock. These include the Category II Atlantic blue crab trap/pot fishery and the Category III Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) 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.

Trap/Pot

During 2016–2020, there were 11 documented entanglement interactions of common bottlenose dolphins in the CES Stock area with crab trap/pot gear within the stranding data. For 10 of the 11 cases, the gear was confirmed to be commercial blue crab trap/pot gear, and for the remaining case, the identity of the gear was not confirmed. During 2016, there was one mortality. During 2017, there was one mortality and one animal released alive, and it could not be determined (CBD) whether the live animal was seriously injured following mitigation efforts (the initial determination was seriously injured; Maze-Foley and Garrison in prep). During 2018, there were two mortalities and two animals released alive, and it could not be determined whether the live animals were seriously injured following mitigation efforts (the initial determinations were seriously injured; Maze-Foley and Garrison in prep). During 2019, there was one mortality, one animal released alive considered seriously injured following mitigation efforts, and one animal released alive considered not seriously injured (no mitigation, the animal became disentangled on its own; Maze-Foley and Garrison in prep). During 2020 one animal was released alive (unidentified crab trap/pot gear case), and it could not be determined whether the animal was seriously injured following mitigation efforts (the initial determination was seriously injured; Maze-Foley and Garrison in prep). The five mortalities, one serious injury, and four CBD cases (CBD cases were prorated based on previous assignable injury events; NMFS 2012; Maze-Foley and Garrison in prep) are included in the annual human-caused mortality and serious injury total for this stock (Table 2), and all 11 cases were documented within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021).

In addition to the interactions documented within the stranding data, one live common bottlenose dolphin was observed at ~~-~~sea in 2018 entangled in unidentified trap/pot gear. It could not be determined whether the animal was seriously injured. This animal was included (prorated) in the annual human-caused mortality and serious injury total for this stock (Table 2).

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.~~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.~~

Hook and Line (Rod and Reel)

During 2016–2020 within the CES area, there was one documented interaction of a common bottlenose dolphin with hook and line fishing gear. During 2017, there was one mortality for which monofilament line was found during the necropsy; however, it could not be determined whether the hook and line gear interaction contributed to cause of death. Thus, this case was not included in the annual human-caused mortality and serious injury total for this stock (Table 2), but it was included within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021).

It should be noted that, in general, it cannot be determined if rod and reel hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no observer program. The documented interaction in this gear represents a minimum known count of interactions in the last five years.

Other Mortality

During 2016–2020, within the CES area, there were two common bottlenose dolphins documented with evidence of vessel strikes, and two animals entangled in unidentified gear. During 2017, there was one mortality documented with propeller wounds including deep penetrating wounds. During 2019, an additional animal was documented with propeller wounds but the wounds were believed to be obtained post-mortem. During 2018, an animal was entangled in rope but disentangled itself and was considered not seriously injured (Maze-Foley and Garrison in prep). Also in 2018, an animal was entangled in unidentified buoy line (either a crab pot buoy or a dredge buoy) and was considered seriously injured (Maze-Foley and Garrison in prep). All four of these interactions were included within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021). The 2017 vessel strike mortality and 2018 unidentified buoy entanglement serious injury were included in the annual human-caused mortality and serious injury total for this stock (Table 2).

All mortalities and serious injuries from known sources for the CES Stock are summarized in Table 2.

Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (*Tursiops truncatus*) of the Charleston 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**
Commercial Blue Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	7.8*a
Unidentified Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	1b

Hook and Line	2016–2020	Stranding Data and At-Sea Observations	NA	0
Mean Annual Mortality due to commercial fisheries (2016–2020)			**1.8**	
Mean Annual Mortality due to other takes (2016–2020) (unid gear entanglement and vessel strike)			**0.4**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)			**2.2**	

a Includes four cases of CBD which were prorated based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison in prep). There were four cases of non-calf entanglements in which the post-mitigation determinations were CBD. The CBDs were prorated as 0.46 serious injuries for each (1.84 total, rounded to 1.8 serious injuries).

b One case of CBD which was prorated based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison in prep). There was one non-calf entanglement in which the initial determination was a CBD (no mitigation), and this case was prorated as a serious injury.

Strandings

~~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).~~

During 2016–2020, 101 common bottlenose dolphins were reported stranded within the CES 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 22 of the strandings. No evidence of human interaction was detected for 36 strandings, and for the remaining 43 strandings, it could not be determined if there was evidence of human interaction. Human interactions were from numerous sources, including entanglements with commercial blue crab trap/pot gear, unidentified trap/pot gear, hook and line gear, an unidentified buoy line, marine debris/rope, and there was also evidence of vessel strikes. 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 ~~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; 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.

Table 3. Common bottlenose dolphin strandings occurring in the Charleston 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**
Charleston Estuarine System Stock	Total Stranded	19	19	18	32	13	101
	HI--Yes	3[a]	5[b]	6[c]	6[d]	2[e]	22
	HI--No	9	8	3	13	3	36
	HI--CBD	7	6	9	13	8	43

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

b. Includes 1 mortality with evidence of a vessel strike and 3 FIs, 2 of which were entanglement interactions with commercial blue crab trap/pot gear (1 mortality; 1 released alive, CBD if seriously injured) and 1 was an entanglement interaction with hook and line gear (mortality).

c. Includes 1 entanglement interaction with an unidentified buoy (released alive, seriously injured), 1 entanglement interaction with rope (released alive, not seriously injured), and 4 FIs, consisting of 4 entanglement interactions with commercial blue crab trap/pot gear (2 mortalities; 2 released alive, CBD if seriously injured).

d. Includes 1 mortality with evidence of a vessel strike and 3 FIs, all of which were entanglement interactions with commercial blue crab trap/pot gear (1 mortality; 1 released alive seriously injured; and 1 released alive, not seriously injured).

e. Includes 1 fishery interaction (FI), an entanglement interaction with unidentified trap/pot gear (released alive, CBD if seriously injured).

~~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.~~

The CES Stock has been affected by two unusual mortality events (UMEs) during the past 15 years. ~~An Unusual Mortality Event (UME)~~ A 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. 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).~~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 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. Charleston Harbor, a busy harbor containing five shipping terminals (Weinpress-Galipeau *et al.* 2021), has been identified as a core area for the stock (Bouchillon *et al.* 2019). 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 common 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 five~~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 common 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 along the U.S. Atlantic coast where the disease has resulted ~~been implicated~~ in UMEs. Serum samples from dolphins within the CES area have ~~been found to be~~ negative ~~for~~ titers of antibodies to both dolphin morbillivirus and porpoise morbillivirus (Rowles *et al.* 2011, Bossart *et al.* 2010), indicating that sampled~~these~~ dolphins have not been exposed to morbillivirus in recent years. Therefore, CES dolphins likely have low levels of ~~little~~ protective antibodies~~y titers~~ and could be vulnerable to infection if the disease were to be introduced into the stock.

During 2003–2013, Bossart *et al.* (2015) examined mucocutaneous lesions in free-ranging common bottlenose dolphins within the CES area and found the presence of orogenital sessile papillomas, nonspecific chronic to chronic-active dermatitis, and epidermal hyperplasia. The study suggested the prevalence of lesions may reflect chronic exposure to anthropogenic and environmental stressors, such as contaminants and infectious or inflammatory disease.

STATUS OF STOCK

Common bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act. However, this stock is considered strategic under the MMPA because the documented mortalities and serious injuries are incomplete and biased low, and likely exceed PBR. While the abundance of the CES Stock is currently unknown, based on previous abundance estimates (Waring *et al*. 2015), it is likely small and therefore relatively few mortalities and serious injuries would exceed PBR. The documented minimum mean annual human-caused mortality for the CES stock for 2016–2020 was 2.2, with an annual average of 1.8 primarily attributed to the blue crab trap/pot and 0.4 from other sources of human mortality (e.g., unknown fishing gear, vessel strikes). However, it is likely the estimate of annual fishery-caused mortality and serious injury is biased low as indicated above (see Annual Human-Caused Mortality and Serious Injury section). In addition, some of the fishery and other sources of human-caused mortalities and serious injuries were averted through mitigation efforts (i.e., disentanglement), and while these are not counted against the stock's PBR (NMFS 2012), when using the documented mean annual human-caused mortality and serious injury as a minimum proxy for the total, such cases are relevant to consider given that undocumented cases cannot be mitigated. Overall, 22% of the animals that stranded during 2016–2020 showed evidence of human interactions, with more than half of those confirmed as fishery interactions (12% of strandings showed evidence of fishery interactions). Wells *et al.* (2015) estimated that only one-third of common bottlenose dolphin carcasses in estuarine environments are recovered, indicating significantly more mortalities occur than are recovered. Therefore, the documented mortalities are incomplete and must be considered minimum counts of total human-caused and 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 optimum sustainable population is unknown. There are insufficient data to determine population trends for this stock.

~~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.~~

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.

Adams, J., T. Speakman, E. Zolman, G. Mitchum, E. Wirth, G.D. Bossart and P.A. Fair. 2014. The relationship between land use and emerging and legacy contaminants in an apex predator, the bottlenose dolphin (*Tursiops truncatus*), from two adjacent estuarine watersheds. Environ. Res. 135:~~-~~346–~~-~~353.

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

Balmer, B.C, S.D. McCulloch, T.R. Speakman, J. Foster, L.J. Hansen, W.E. McFee and G.D. Bossart. 2021. Comparison of short-term satellite telemetry and long-term photographic-identification for assessing ranging patterns of individual common bottlenose dolphins (*Tursiops truncatus*) in the waters around Charleston, South Carolina USA. Aquat. Mamm. 47(4):355–361.

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., J.S. Reif, A.M. Schaefer, J. Goldstein, P.A. Fair and J.T. Saliki. 2010. Morbillivirus infection in free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) from the southeastern United States: seroepidemiologic and pathologic evidence of subclinical infection. Vet. Microbiol. 143:160–166.

Bossart, G.D., A.M. Schaefer, S. McCulloch, J. Goldstein, P.A. Fair and J.S. Reif. 2015. Mucocutaneous lesions in free-ranging Atlantic bottlenose dolphins *Tursiops truncatus* from the southeastern USA. Dis. Aquat. Org. 115:175–184.

Bouchillon, H., N.S. Levine, and P.A. Fair. 2019. GIS investigation of the relationship of sex and season on the population distribution of common bottlenose dolphins (*Tursiops truncatus*) in Charleston, South Carolina. Int. J. Geogr. Inf. Syst. Sci. DOI: 10.1080/13658816.2019.1615068

~~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.~~

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112:1–23.

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

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

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. Aquat. Mamm. 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.

Kucklick, J., L. Schwacke, R. Wells, A. Hohn, A. Guichard, J. Yordy, L. Hansen, E. Zolman, R. Wilson, J. Litz, D. Nowacek, T. Rowles, R. Pugh, B. Balmer, C. Sinclair and P. Rosel. 2011. Bottlenose dolphins as indicators of persistent organic pollutants in the western North Atlantic Ocean and northern Gulf of Mexico. Environ. Sci. Technol. 45:4270–4277.

Laska, D., T. Speakman and P.A. Fair. 2011. Community overlap of bottlenose dolphins (*Tursiops truncatus*) found in coastal waters near Charleston, South Carolina. JMATE 4(2):10–18.

Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1):107–117.

Maze-Foley, K. and L.P. Garrison. in prep. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2022-XX. XX pp.

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

~~Maze-Foley, K. and L.P. Garrison. in prep a. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2007-2011.~~

~~Maze-Foley, K. and L.P. Garrison. in prep b. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2012.~~

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. Fla. Sci. 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.

Morris, S.E., J.L. Zelner, D.A. Fauquier, T.K. Rowles, P.E. Rosel, F. Gulland and B.T. Grenfell. 2015. Partially observed epidemics in wildlife hosts: Modelling an outbreak of dolphin morbillivirus in the northwestern Atlantic, June 2013–2014. J. R. Soc. Interface 12:20150676.

NMFS 2012. Process for distinguishing serious from non-serious injury of marine mammals: Process for injury determinations. National Marine Fisheries Service Policy Directive PD 02-038-01. January 2012. Available from: http://www.nmfs.noaa.gov/pr/laws/mmpa/policies.htm [Federal Register Notice, Vol. 77, No. 14, page 3233, January 23, 2012]

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available at: http://www.nmfs.noaa.gov/op/pds/index.html

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18:278–290.

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Molec. Ecol. 18:5030–5045.

Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded common bottlenose dolphins in southeastern Louisiana after the Deepwater Horizon oil spill. Endang. Species Res. 33:221–234.

Rowles, T.K., L.S. Schwacke, R.S. Wells, J.T. Saliki, L. Hansen, A. Hohn, F. Townsend, R.A. Sayre and A.J. Hall. 2011. Evidence of susceptibility to morbillivirus infection in cetaceans from the United States. Mar. Mamm. Sci. 27(1):1–19.

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.

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. Conserv. Genet. 6(5):715–728.

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.

Speakman, T., S.M. Lane, L.H. Schwacke, P.A. Fair and E.S. Zolman. 2010. Mark-recapture estimates of seasonal abundance and survivorship for bottlenose dolphins (*Tursiops truncatus*) near Charleston, South Carolina, USA. J. Cetacean Res. Manage. 11(2):153–162.

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, K. Maze-Foley, P. E. Rosel. 2015. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments - 2014. NOAA Tech. Memo. NMFS-NE-231. 370 pp.

Weinpress-Galipeau, M., H. Baker, B. Wolf, B. Roumillat and P.A. Fair. 2021. An adaptive bottlenose dolphin foraging tactic, "shipside feeding," using container ships in an urban estuarine environment. Mar. Mamm. Sci. 37(3):1159–1165.

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1):355–368.

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.

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.

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*)
Northern Georgia/Southern 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 of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002a; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; 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~~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).~~

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

Estuarine areas in southern South Carolina and northern Georgia are characterized by extensive tidal marshes, shallow lagoonal estuaries, and riverine input (Savannah, Coosawhatchie, Combahee Rivers). Estuarine circulation patterns are dominated mainly by freshwater inflow and tides in South Carolina and Georgia. This region includes the large population centers of Savannah, Georgia, and Hilton Head, South Carolina, which are also areas of significant tourism.

From 1994 to 1998, Gubbins (2002a,b,c) surveyed an area around Hilton Head Island bordered on the north by the May River, on the south by the Calibogue Sound, on the west by Savage Creek and on the east by Hilton Head Island. Broad Creek, which bisects Hilton Head Island, and nearshore ocean waters out to 2 km at the mouth of Calibogue Sound were ~~included and were~~ regularly surveyed. Occasional surveys were made around ~~the perimeter of~~ Hilton Head Island. Gubbins (2002b) categorized each dolphin identified in the Hilton Head area as a year-round resident or a seasonal transient based on overall resighting patterns. Residents were seen in all four~~4~~ seasons whereas transients were seen only in one~~1~~ or two~~2~~ seasons. Resident dolphins were observed from 10 to 116 times, whereas transients were observed fewer than nine ~~9~~ times (Gubbins 2002b). Sixty-four percent of the dolphins photographically identified were resighted only once between 1994 and 1998. Both resident and transient dolphins occurred in the waters of Calibogue Sound (Gubbins 2002b,c; Gubbins *et al.* 2003), whereas in the tidal creeks and rivers, primarily small, tight groups of resident dolphins were seen, with only an occasional transient dolphin. Two dolphins were resighted between Hilton Head and Jacksonville, which likely represent transients or seasonal residents (Gubbins 2002b). Gubbins *et al.* (2003) reported dolphin abundance in the Hilton Head area was lowest from February to April, with two~~2~~ peaks in abundance observed in May and July. Some dolphins were sighted for short periods in the summer, indicating transients or seasonal residents may move inshore to this area during the summer months.

Griffin *et al.* (2021) used genetic and photo-ID data to examine fine-scale population structure of common bottlenose dolphins in northern Georgia, from the southern Savannah River channel to northern Ossabaw Sound, which encompassed the southernmost portion of the Northern Georgia/Southern South Carolina Estuarine System (NGSSCES) Stock and a small portion of the northernmost section of the Central Georgia Estuarine System (CGES) Stock. No significant genetic differentiation was found among three a priori defined regions within the study area when the full sample set was utilized, but after using photo-ID data to identify dolphins with ≥ 10 sightings and assigning them to the region they utilized most, a significant genetic difference was found between the north region and the other two regions. Further work is necessary to evaluate whether multiple demographically independent populations exist within the NGSSCES Stock.

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

POPULATION SIZE

The total number of common bottlenose dolphins residing within the NGSSCES Stock is unknown (Table 1).

Earlier abundance estimates (>8 years old)

Data collected by Gubbins (2002b) were incorporated into a larger study that used mark-recapture analyses to calculate abundance in four~~4~~ estuarine areas along the eastern U.S. coast (Gubbins *et al.* 2003). Sighting records collected only from May through October were used. Based on photo-ID data from 1994 to 1998, 234 individually identified dolphins were observed (Gubbins *et al.* 2003), which included 52 year-round residents and an unspecified number of seasonal residents and transients. Mark-recapture analyses included all the 234 individually identifiable dolphins and the population size for the Hilton Head area was estimated to be 525 dolphins (CV=0.16; Gubbins *et al.* 2003). This was an overestimate of the resident stock abundance within the study area because it included non-resident and seasonally resident dolphins. In addition, the study area did not encompass the entire area occupied by the NGSSCES Stock and therefore this population size could~~cannot~~ not be considered a reliable estimate of abundance for this stock. ~~Finally, as recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates greater than 8 years old are deemed unreliable.~~

Minimum Population Estimate

No current information on abundance is available to calculate a minimum population estimate for the NGSSCES Stock of common bottlenose dolphins.~~The minimum population estimate for this stock of common bottlenose dolphins is unknown. Present data are insufficient to calculate a minimum population estimate for the Northern Georgia/Southern South Carolina Estuarine System Stock of common bottlenose dolphins.~~

Current Population Trend

No reliable abundance estimate is available for this stock, and therefore there are insufficient data to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the NGSSCES Stock is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5 because this stock is of unknown status. PBR for the NGSSCES Stock of common bottlenose dolphins is unknown (Table 1).

Table 1. Best and minimum abundance estimates (Nest and Nmin) for the Northern Georgia/Southern South Carolina Estuarine System Stock of common bottlenose dolphins with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

Nest	CV Nest	Nmin	Fr	Rmax	PBR
Unknown	-	Unknown	0.5	0.04	Unknown

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the NGSSCES Stock during 2016–2020~~2009-2013~~ 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 1.3. Additional mean annual mortality and serious injury during 2016–2020 due to other human-caused sources was 0.2 (vessel strike). The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 1.5 (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). ~~because this stock is known to interact with unobserved fisheries (see below). The mean annual fishery-related mortality and serious injury for strandings and at-sea observations identified as fishery-caused was 1.4. No additional mortality or serious injury was documented from other human-caused actions. The minimum total mean annual human-caused mortality and serious injury for this stock during 2009-2013 was 1.4.~~

Fishery Information

~~The commercial fisheries that interact, or that potentially could interact, with this stock are the Category II Atlantic blue crab trap/pot fishery and the Category III Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fishery (Appendix III).~~There are two commercial fisheries that interact, or potentially interact, with this stock. These include the Category II Atlantic blue crab trap/pot fishery and the Category III Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) 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.

~~Atlantic Blue Crab~~ Trap/Pot

During 2016–2020, there were six documented entanglement interactions of common bottlenose dolphins in the NGSSCES Stock area with crab trap/pot gear. For five of the six cases, the gear was confirmed to be commercial blue crab trap/pot gear, and for the remaining case, the gear was unidentified trap/pot gear. During 2016, there was one mortality, and during 2017, there were two mortalities. During 2018, there was one mortality and one animal released alive, and it could not be determined (CBD) whether the live animal was seriously injured following mitigation efforts (the initial determination was seriously injured; Maze-Foley and Garrison in prep). During 2020, there was one mortality (unidentified gear). The five mortalities and one CBD for serious injury (the CBD case was prorated based on previous assignable injury events; NMFS 2012; Maze-Foley and Garrison in prep) are included in the annual human-caused mortality and serious injury total for this stock (Table 2), and all six cases were 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 crab trap/pot fisheries. The documented interactions in this gear represent a minimum known count of interactions in the last five years.

~~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, 5 bottlenose dolphin strandings were reported entangled in crab trap/pot gear in the NGSSCES (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11 June 2014). Three of the 5 strandings were mortalities. Two of the 5 animals were released alive, 1 of which was without serious injury and the other was seriously injured (Maze-Foley and Garrison in prep a,b,c). For 2 cases the pot gear was identified as commercial blue crab, for 1 case it was identified as recreational, and the remaining 2 cases were unidentified as to pot gear type. In addition to animals included in the stranding database, in 2009 there was an at-sea observation of a dolphin entangled in a crab pot buoy and line, and this animal was considered seriously injured (Maze-Foley and Garrison in prep a). 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.~~

Hook and Line (Rod and Reel)

During 2016–2020, within the NGSSCES area, there was one documented interaction within the stranding data of a common bottlenose dolphin entangled in hook and line fishing gear. The interaction occurred during 2020, and the live animal was considered seriously injured (Maze-Foley and Garrison in prep). This serious injury is included in the annual human-caused mortality and serious injury total for this stock (Table 2), and the case was included in the stranding database and in the stranding totals presented in Table 3 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021).

It should be noted that, in general, it cannot be determined if rod and reel hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no observer program. The documented interaction in this gear represents a minimum known count of interactions in the last five years.~~During 2009-2013, 2 interactions (mortalities) with hook and line gear were documented within the NGSSCES area. During 2010, 1 dolphin was documented with monofilament line wrapped around its flukes, and 1 dolphin was documented with an ingested fishing lure. Both of these mortalities were included in the stranding database and are included in the stranding totals presented in Table 1. It should be noted that, in general, it cannot be determined if hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no systematic observer program.~~

Other Mortality

During 2016–2020 within the NGSSCES area, there was one common bottlenose dolphin released alive in 2016 considered not seriously injured following entanglement in research gillnet gear (bonnethead shark research; Maze-Foley and Garrison in prep), and one documented mortality in 2020 of a common bottlenose dolphin with evidence of a vessel strike (series of propeller wounds). Both of these interactions were included within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021). The 2020 vessel strike mortality was included in the annual human-caused mortality and serious injury total for this stock (Table 2).

All mortalities and serious injuries from known sources for the NGSSCES 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 Georgia/Southern 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
Commercial Blue Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	4.5*a
Unidentified Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	1
Hook and Line	2016–2020	Stranding Data and At-Sea Observations	NA	1
Mean Annual Mortality due to commercial fisheries (2016–2020)			**1.3**	
Mean Annual Mortality due to other takes (2016–2020) (vessel strike)			**0.2**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)			**1.5**	

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 in prep).

Strandings

During 2016–2020, 71 common bottlenose dolphins were reported stranded within the NGSSCES 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 14 of the strandings. No evidence of human interaction was detected for 20 strandings, and for the remaining 37 strandings, it could not be determined if there was evidence of human interaction. Human interactions were from numerous sources, including entanglements with commercial blue crab trap/pot gear, recreational trap/pot gear, hook and line gear, research gillnet gear, and evidence of a vessel strike. 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.

~~From 2009 to 2013, 105 common bottlenose dolphin strandings were documented within the NGSSCES area (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11 June 2014). There was evidence of human interactions for 18 strandings in total, 11 of which were fisheries interactions including the 5 interactions with crab trap/pot gear and 2 interactions with hook and line gear discussed above. No evidence of human interactions was found for 27 strandings, and for the remaining 60 strandings, it could not be determined if there was evidence of human interactions. 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.~~

The NGSSCES Stock has been affected by two unusual mortality events (UMEs) during the past 15 years. ~~An Unusual Mortality Event (UME)~~ A UME was declared in South Carolina during February–~~-~~May 2011. Twelve strandings assigned to the NGSSCES Stock were 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).~~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, 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 and work continues to determine the effect of this event on all bottlenose dolphin stocks in the Atlantic.~~

Table 3. Common bottlenose dolphin strandings occurring in the Northern Georgia/Southern 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 Georgia/Southern South Carolina Estuarine System Stock	Total Stranded	18	13	19	7	14	71
	HI--Yes	4a	3b	4c	0	3d	14
	HI--No	5	6	2	1	6	20
	HI--CBD	9	4	13	6	5	37

a Includes 1 entanglement in research gillnet gear (alive, not seriously injured) and 1 fishery interaction (FI), an entanglement interaction with commercial blue crab trap/pot gear (mortality).

b Includes 2 FIs, both of which were entanglement interactions with commercial blue crab trap/pot gear (mortalities).

c Includes 2 FIs, both of which were entanglement interactions with commercial blue crab trap/pot gear (1 mortality; 1 released alive, CBD if seriously injured).

d Includes 1 mortality with evidence of a vessel strike and 2 FIs, 1 of which was entanglement interaction with hook and line gear (released alive, seriously injured) and the other was an entanglement interaction with recreational trap/pot gear (mortality).

~~Table 1. Common bottlenose dolphin strandings occurring in the Northern Georgia/Southern South Carolina Estuarine System Stock area during 2009 to 2013, as well as number of strandings for which evidence of human interactions (HI) 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~~
~~Northern Georga/Southern South Carolina Estuarine System Stock~~	~~Total Stranded~~	~~9~~	~~21~~	~~27[a]~~	~~21~~	~~27~~	~~105~~
	~~Human Interaction~~						
	~~---Yes~~	~~3[b]~~	~~6[c]~~	~~3[d]~~	~~2[e]~~	~~4[f]~~	~~18~~
	~~---No~~	~~1~~	~~10~~	~~7~~	~~3~~	~~6~~	~~27~~
	~~---CBD~~	~~5~~	~~5~~	~~17~~	~~16~~	~~17~~	~~60~~

~~[a] This total includes 12 animals that were part of the 2011 UME event in South Carolina.~~

~~[b] This total includes 2 fisheries interactions (FIs), 1 of which was an animal partially disentangled from recreational trap/pot gear by a member of the public and released alive in unknown condition.~~

~~[c] This total includes 5 FIs. Two FIs were entanglement interactions in crab trap/pot gear (mortalities), and 2 FIs involved hook and line gear (mortalities).~~

~~[d] This total includes 1 FI that was as entanglement interaction in commercial blue crab trap/pot gear (mortality).~~

~~[e] This total includes 1 FI.~~

~~[f] This total includes 2 FIs, 1 of which was an entanglement interaction with commercial blue crab trap/pot gear (released alive, not seriously injured).~~

HABITAT ISSUES

This stock inhabits areas with significant drainage from urban and agricultural areas and as such is exposed to contaminants in runoff from those sources. In other estuarine areas where contaminant analyses have been conducted, it has been suggested that exposure to anthropogenic contaminants could potentially result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Analyses of contaminants has been conducted only in the southernmost portion of this stock's range comparing PCB concentrations between dolphins stranded in the Savannah area (Wassaw, Ossabaw and St. Catherine's Sounds) and dolphins using the Turtle/Brunswick River Estuary (TBRE; Pulster and Maryua 2008; Pulster *et al.* 2009). Total PCB concentrations were 10 times higher in dolphins from the TBRE compared to the stranded animals from the Savannah area. The signature of Aroclor 1268, a PCB used in roofing and caulking compounds, was distinct between the TBRE and Savannah area dolphins and closely resembled those of local TBRE prey fish species (Pulster and Maruya 2008; Pulster *et al.* 2009).

Illegal feeding or provisioning of wild bottlenose dolphins has been documented in Georgia, particularly near Brunswick and Savannah (Kovacs and Cox 2014; Perrtree *et al.* 2014; Wu 2013). Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter the ~~natural~~ behavior and increase the risk of injury or death to wild dolphins. Dolphins in estuarine waters near Savannah recently showed the highest rate of begging behavior reported from any study site worldwide (Perrtree *et al.* 2014). Another study in the same Savannah study area by Hazelkorn *et al.* (2016) showed behavioral differences between beggar and non-beggar dolphins, and suggested a persistent behavioral shift may be taking place whereby dolphin-human interactions are increasing, which in turn could result in an increase in injuries to the dolphins. There are ~~emerging questions regarding potential~~ links~~ages~~ between provisioning wild dolphins, dolphin depredation of recreational fishing gear, and associated entanglement and ingestion of gear (Powell and Wells 2011; Christiansen *et al.* 2016; Powell *et al.* 2018).

High boat activity in the Hilton Head area could result in a change in movement patterns, alteration of behavior of both dolphins and their prey, disruption of echolocation and masking of communication, physical damage to ears, collisions with vessels and degradation of habitat quality (Richardson *et al.* 1995; Ketten 1998; Gubbins 2002b; Gubbins *et al.* 2003; Mattson *et al.* 2005). The effect of boat and jet ski activity was investigated by Mattson *et al.* (2005) during the summer of 1998 along Hilton Head Island. Dolphins changed behavior more often when boats were present, and group size was significantly larger in the presence of one~~1~~ boat and was largest when multiple boats were present. Jet skis elicited a strong and immediate reaction with dolphins remaining below the surface for long periods of time. Dolphins always changed behavior and direction of movement in the presence of shrimp boats, while ships and ferries elicited little to no obvious response. The long-term impacts of such repeated harassment and disturbance on survival and reproduction remain to be determined.

STATUS OF STOCK

Common bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act. However, this stock is considered strategic under the MMPA because the documented mortalities and serious injuries are incomplete and biased low, and likely exceed PBR. While the abundance of the NGSCCES Stock is currently unknown, based on the previous abundance estimate (Waring *et al.* 2015), it is likely small and therefore relatively few mortalities and serious injuries would exceed PBR. The documented minimum mean annual human-caused mortality for the NGSCCES stock for 2016–2020 was 1.5, with an annual average of 1.3 primarily attributed to the blue crab trap/pot and 0.2 from other sources of human mortality (e.g., vessel strike). However, it is likely the estimate of annual fishery-caused mortality and serious injury is biased low as indicated above (see Annual Human-Caused Mortality and Serious Injury section). In addition, some of the fishery and other sources of human-caused mortalities and serious injuries were averted through mitigation efforts (i.e., disentanglement), and while these are not counted against the stock's PBR (NMFS 2012), when using the documented mean annual human-caused mortality and serious injury as a minimum proxy for the total, such cases are relevant to consider given that undocumented cases cannot be mitigated. Overall, 20% of the animals that stranded during 2016–2020 showed evidence of human interactions, and half of those were confirmed as fishery interactions. Wells *et al.* (2015) estimated that only one-third of common bottlenose dolphin carcasses in estuarine environments are recovered, indicating significantly more mortalities occur than are recovered. Therefore, the documented mortalities are incomplete and must be considered minimum counts of total human-caused and 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 optimum sustainable population is unknown. There are insufficient data to determine population trends for this stock. ~~However, because the abundance of the NGSSCES 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. The documented mean annual human-caused mortality and serious injury for this stock for 2009 – 2013 was 1.4. However, there are commercial fisheries, including crab trap/pot fisheries, operating within this stock's boundaries and these fisheries have little to no observer coverage. The impact of crab trap/pot fisheries on estuarine bottlenose dolphins is currently unknown, but has been shown previously to be considerable in the similar Charleston Estuarine System Stock area (Burdett and McFee 2004). Therefore, the documented mortalities and serious injuries must be considered minimum estimates of total fishery-related mortality and serious injury. 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 in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this stock.~~

REFERENCES CITED

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.

~~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.~~

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112:1–23.

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

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

Christiansen, F., K.A. McHugh, L. Bejder, E.M. Siegal, D. Lusseau, E.B. McCabe, G. Lovewell, R.S. Wells. 2016. Food provisioning increases the risk of injury in a long-lived marine top predator. R. Soc. open sci. 3: 160560.

Griffin, E.K., P.E. Rosel, B.C. Balmer, R.M. Perrtree and T.M. Cox. 2021. Using photo-identification and genetic data to examine fine-scale population structure of common bottlenose dolphins (*Tursiops truncatus*) in the estuarine waters surrounding Savannah, Georgia. Aquat. Mamm. 47(3):245–256.

Gubbins, C. 2002a. Association patterns of resident bottlenose dolphins (*Tursiops truncatus*) in a South Carolina estuary. Aquat. Mamm. 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 Environ. 319:147–172.

Hazelkorn, R.A., B.A. Schulte and T.M. Cox. 2016. Persistent effects of begging on common bottlenose dolphin (*Tursiops truncatus*) behavior in an estuarine population. Aquat. Mamm. 42(4):531–541.

Ketten, D.R. 1998. Marine mammal auditory systems: A summary of audiometric and anatomical data and its implications for underwater acoustic impacts. NOAA Tech. Memo. NMFS-SWFSC-256. 74 pp.

Kovacs, C. and T. Cox. 2014. Quantification of interactions between common bottlenose dolphins (*Tursiops truncatus*) and a commercial shrimp trawler near Savannah, Georgia. Aquat. Mamm. 40(1):81–94.

Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1):107–117.

Mattson, M.C., J.A. Thomas and D.S. Aubin. 2005. Effects of boat activity on the behavior of bottlenose dolphins (*Tursiops truncatus*) in waters surrounding Hilton Head, South Carolina. Aquat. Mamm. 31(1):133–140.

Maze-Foley, K. and L.P. Garrison. in prep. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2022-XX. XX pp.

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

~~Maze-Foley, K. and L.P. Garrison. in prep a. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2007-2011.~~

~~Maze-Foley, K. and L.P. Garrison. in prep b. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2012.~~

~~Maze-Foley, K. and L.P. Garrison. in prep c. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2013.~~

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. Fla. Sci. 68(4): 217–226.

Morris, S.E., J.L. Zelner, D.A. Fauquier, T.K. Rowles, P.E. Rosel, F. Gulland and B.T. Grenfell. 2015. Partially observed epidemics in wildlife hosts: Modelling an outbreak of dolphin morbillivirus in the northwestern Atlantic, June 2013–2014. J. R. Soc. Interface 12:20150676.

NMFS 2012. Process for distinguishing serious from non-serious injury of marine mammals: Process for injury determinations. National Marine Fisheries Service Policy Directive PD 02-038-01. January 2012. Available from: http://www.nmfs.noaa.gov/pr/laws/mmpa/policies.htm [Federal Register Notice, Vol. 77, No. 14, page 3233, January 23, 2012]

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available at: http://www.nmfs.noaa.gov/op/pds/index.html

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18: 278–290.

Perrtree, R.M., C.J. Kovacs and T.M. Cox. 2014. Standardization and application of metrics to quantify human-interaction behaviors by the bottlenose dolphin (*Tursiops* spp.). Mar. Mamm. Sci. 30(4): 1320–1334.

Powell, J.R. and R.S. Wells. 2011. Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Mar. Mamm. Sci. 27(1): 111–129.

Powell, J.R., A.F. Machernis, L.K. Engleby, N.A. Farmer and T.R. Spradlin. 2018. Sixteen years later: An updated evaluation of the impacts of chronic human interactions with bottlenose dolphins (*Tursiops truncatus*) in Panama City, Florida, USA. J. Cetacean Res. Manage. 19:79–93.

Pulster, E.L. and K.A. Maruya. 2008. Geographic specificity of Aroclor 1268 in bottlenose dolphins (*Tursiops truncatus*) frequenting the Turtle/Brunswick River Estuary, Georgia (USA). Sci. Total Environ. 393: 367–375.

Pulster, E.L., K.L. Smalling, E. Zolman, L. Schwacke and K. Maruya. 2009. Persistent organochlorine pollutants and toxaphene congener profiles in bottlenose dolphins (*Tursiops truncatus*) frequenting the Turtle/Brunswick River Estuary, Georgia, USA. Env. Toxic. Chem. 28(7): 1390–1399.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme and D. Thomas, II. 1995. Marine mammals and noise. Academic Press, San Diego, CA. 576 pp.

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Molec. Ecol. 18: 5030–5045.

Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded common bottlenose dolphins in southeastern Louisiana after the Deepwater Horizon oil spill. Endang. Species Res. 33:221–234.

Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Env. Toxic. Chem. 21(12): 2752–2764.

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. Conserv. Genet. 6(5): 715–728.

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.

Urian, K.W., A.A. Hohn and L.J. Hansen. 1999. Status of the photoidentification catalog of coastal bottlenose dolphins of the western North Atlantic: Report of a workshop of catalog contributors. NOAA Tech. Memo. NMFS-SEFSC-425. 22 pp.

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.

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1): 355–368.

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.

Wu, C. 2013. Human and boat interactions with common bottlenose dolphins (*Tursiops truncatus*) in the waterways around Savannah, Georgia. M. Sc. thesis. Savannah State University, Savannah, Georgia. 101 pp.

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.

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*) Central Georgia 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 of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; 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). ~~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).~~

Figure 1. ***Geographic extent of the Central Georgia Estuarine System (CGES) Stock. Dashed lines denote the boundaries.***

Coastal central and northern Georgia contains an extensive estuarine tidal marsh system in which common bottlenose dolphins are documented. The primary river drainages in this region are the Altamaha in central Georgia and the Savannah River at the Georgia-South Carolina border. Much of the coastal marsh and islands in the area ha~~ve~~s been privately owned since the early 19th century and ha~~ve~~s therefore experienced little development, and the marshes and coastal region are ~~therefore~~ relatively undisturbed. The Sapelo Island National Estuarine Research Reserve, part of NOAA's Estuarine Reserve System, lies in this section of the Georgia coast and includes 4,000 acres of tidal salt marsh.

The Central Georgia Estuarine System Stock (CGES) is delineated in the estuarine waters of central Georgia (Figure 1). It extends from the northern extent of Ossabaw Sound, where it meets the border with the Northern Georgia/Southern South Carolina Estuarine System Stock, south to the Altamaha River, which provides the border between the CGES and the Southern Georgia Estuarine System Stock. Nearshore (≤ 1 km from shore) coastal waters are also included in the CGES Stock boundaries.

The boundaries of this stock are supported by photo-ID data~~ and genetic data~~. Balmer *et al.* (2011) conducted photo-ID studies between 2004 and 2009 in the Turtle/Brunswick River estuary (TBRE) in southern Georgia and in estuarine habitats ~~north of the~~from Altamaha Sound north to Sapelo Sound. Photo-ID data revealed strong site fidelity to the two regions and supported Altamaha Sound as an appropriate boundary between the two stock~~ite~~s as 85.4% of animals identified did not cross Altamaha Sound (Balmer *et al.* 2013). Just over half the animals that did range across Altamaha Sound had low site fidelity and were believed to be members of the South Carolina/Georgia Coastal Stock. ~~Genetic analysis of mitochondrial DNA control region sequences and microsatellite markers of dolphins biopsied in southern Georgia showed significant genetic differentiation from animals biopsied in northern Georgia and southern South Carolina estuaries as well as from animals biopsied in coastal waters >1 km from shore at the same latitude (NMFS unpublished data).~~ In addition, common bottlenose dolphins sampled within the Sapelo Island area exhibited contaminant burdens significantly lower than those sampled to the south in the TBRE (Balmer *et al.* 2011; Kucklick *et al.* 2011), consistent with long-term fidelity to these separate areas. Analyses to determine whether multiple demographically independent populations exist within this stock have not been performed to date.

POPULATION SIZE

The current total number of common bottlenose dolphins residing within the CGES Stock is unknown because previous estimates are more than 8 years old (Table 1; NMFS 2016).

Earlier abundance estimates (>8 years old)

During 2008–~~-~~2009, seasonal, mark-recapture photo-ID surveys were conducted to estimate abundance in a portion of the CGES area from Altamaha Sound north to Sapelo Sound. Estimates from winter were chosen as the best representation of the resident estuarine stock in the area surveyed, and a Markovian emigration model was chosen as the best fit based on the lowest Akaike's Information Criterion value. The estimated average abundance, based on winter 2008 and winter 2009 surveys, was 192 (CV=0.04; Balmer *et al.* 2013). Estimates were adjusted to include the 'unmarked' (not distinctive) as well as 'marked' (distinctive) portion of the population for each winter survey. It is important to note this estimate covered approximately half of the entire range of the CGES Stock, and therefore, the abundance estimate is negatively biased.

Minimum Population Estimate

No current information on abundance is available to calculate a minimum population estimate for the CGES Stock of common bottlenose dolphins.~~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 CGES Stock is 192 (CV=0.04). The resulting minimum population estimate is 185.~~

Current Population Trend

There are insufficient data to determine the population trends for this stock because only one estimate of population size is available.~~One abundance estimate is available for this stock, and therefore there are insufficient data to assess population trends.~~

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 CGES Stock of common bottlenose dolphins is unknown~~185~~. 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 the~~is~~ CGES ~~s~~Stock of common bottlenose dolphins is undetermined~~1.9~~ (Table 1).

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

Nest	CV Nest	Nmin	Fr	Rmax	PBR
Unknown	-	Unknown	0.5	0.04	Undetermined

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the CGES Stock during 2016–2020~~2009-2013~~ 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 0.2. Additional mean annual mortality and serious injury during 2016–2020 due to other human-caused sources (vessel strike) was 0.2. The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 0.4 (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).~~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~~The commercial fishery that interacts, or has the potential to interact, with this stock is~~ with~~ the Category II Atlantic blue crab trap/pot fishery~~ (Appendix III)~~. 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.

~~Atlantic Blue Crab~~ Trap/Pot

During 2016–2020 there was one documented entanglement interaction of a common bottlenose dolphin in the CGES Stock area in commercial blue crab trap/pot gear. The interaction was a mortality occurring in 2019, and is included in the annual human-caused mortality and serious injury total for this stock (Table 2), and 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 crab trap/pot fisheries. The documented interaction in this gear represents a minimum known count of interactions in the last five years.

~~During 2009-2013 there were 2 documented interactions with commercial blue crab trap/pot gear in the CGES area. The interactions occurred during 2011 and 2013, and both involved an animal that was disentangled and released alive without serious injury (Maze-Foley and Garrison in prep a,b,c). These animals were included in the stranding database and in the totals in Table 1 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11 June 2014). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab trap/pot gear.~~

Other Mortality

During 2016–2020 within the CGES area, two common bottlenose dolphins were documented with evidence of vessel strikes. In 2019, a mortality was documented with well-healed vessel strike wounds and it was considered improbable the wounds contributed to the mortality. In 2020, another mortality was documented and it was determined the mortality was due to the vessel strike impact. Both of these mortalities were included within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15

June 2021). The 2020 vessel strike mortality was included in the annual human-caused mortality and serious injury total for this stock (Table 2).

All mortalities and serious injuries from known sources for the CGES Stock are summarized in Table 2.

Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (*Tursiops truncatus*) of the Central Georgia 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.

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**
Commercial Blue Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	1
Mean Annual Mortality due to commercial fisheries (2016–2020)			**0.2**	
Mean Annual Mortality due to other takes (2016–2020) (vessel strike)			**0.2**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)			**0.4**	

Strandings

During 2016–2020, 24 common bottlenose dolphins were reported stranded within the CGES 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 four of the strandings. No evidence of human interaction was detected for one stranding, and for the remaining 19 strandings it could not be determined if there was evidence of human interaction. Human interactions included an entanglement with commercial blue crab trap/pot gear and evidence of vessel strikes. 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.

~~From 2009 to 2013, 24 common bottlenose dolphins were reported stranded within the CGES (NOAA National Marine~~

~~Mammal Health and Stranding Response Database unpublished data, 11 June 2014). It could not be determined if there was evidence of human interaction for 20 of these strandings due to most (79%) were in a state of moderate or advanced decomposition when first observed. For 2 dolphins, no evidence of human interactions was detected. The remaining 2 strandings were fishery interactions with commercial crab trap/pot gear, described above. 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.~~

The CGES Stock has been affected by one unusual mortality event (UME) during the past 15 years. A 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).~~An Unusual Mortality Event (UME) was declared in the summer of 2013 for the mid-Atlantic coast from New York to Brevard County, Florida. Beginning in July 2013, 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 and work continues to determine the effect of this event on all bottlenose dolphin stocks in the Atlantic.~~

Table 3. Common bottlenose dolphin strandings occurring in the Central Georgia 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**
Central Georgia Estuarine System Stock	Total Stranded	7	3	4	3	7	24
	HI--Yes	0	1	0	2a	1b	4
	HI--No	0	0	0	0	1	1
	HI--CBD	7	2	4	1	5	19

a. Includes 1 animal with evidence of a vessel strike and 1 fisheries interaction, an entanglement interaction with commercial blue crab trap/pot gear (mortality).

b. Includes 1 animal with evidence of a vessel strike.

~~Table 1. Common bottlenose dolphin strandings occurring in the Central Georgia Estuarine System Stock area during 2009 to 2013, as well as number of strandings for which evidence of human interactions (HI) 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**~~
~~Central Georgia Estuarine System Stock~~	~~Total Stranded~~	~~1~~	~~1~~	~~6~~	~~5~~	~~11~~	~~24~~
	~~Human Interaction~~						
	~~---Yes~~	~~0~~	~~0~~	~~1[a]~~	~~0~~	~~1[b]~~	~~2~~
	~~---No~~	~~0~~	~~0~~	~~0~~	~~1~~	~~1~~	~~2~~
	~~---CBD~~	~~1~~	~~1~~	~~5~~	~~4~~	~~9~~	~~20~~

~~[a] This includes 1 fisheries interaction (FI) in which a dolphin was disentangled from commercial blue crab trap/pot gear and released alive without serious injury.~~

~~[b] This includes 1 FI in which a dolphin was disentangled from commercial blue crab trap/pot gear and released alive without serious injury.~~

HABITAT ISSUES

This stock is found in relatively pristine estuarine waters of central Georgia. Much of the area has ~~had~~ been privately owned since the end of the 19th century and ~~not been~~has remained undeveloped, leaving the marshes relatively undisturbed. This stock's area includes the Sapelo Island National Estuarine Research Reserve ~~(SINERR)~~, which is part of NOAA's National Estuarine Research Reserve system ~~(NERR)~~, and several National Wildlife Refuges. Just to the south of this stock's range, however, the estuarine environment around Brunswick, Georgia, is highly industrialized and the Environmental Protection Agency has included four~~4~~ sites within the Brunswick area as Superfund hazardous waste sites. This region is known to be contaminated with a specific PCB mixture, Aroclor 1268, in soil and sediments, and the transport of these contaminants into the food web through invertebrate and vertebrate fauna has been documented (Kannan *et al.* 1997; Kannan *et al.* 1998; Maruya and Lee 1998). Balmer *et al.* (2013) measured PCB concentrations in dolphins sampled near Sapelo Island and found concentrations, including detection of Aroclor 1268, lower than those found in dolphins from the Brunswick, Georgia area, but still high when compared to other common bottlenose dolphin stocks along the eastern seaboard. Given little evidence for movement of dolphins between these two areas (Balmer *et al.* 2011, 2013), the dolphins near Sapelo~~,~~ Island in the CGES Stock may be obtaining the high contaminant loads through eating contaminated prey (Balmer *et al.* 2011). Further work is necessary to examine contaminant and movement patterns of dolphin prey species in this region.

Studies have suggested an increased risk of detrimental effects on reproduction and endocrine and immune system function for marine mammals in relation to tissue concentrations of PCBs (De Swart *et al.* 1996; Kannan *et al.* 2000; Schwacke *et al.* 2002). PCB-related health effects on common bottlenose dolphins along the Georgia coast were examined through a capture-release health assessment conducted during 2009 in the Brunswick area and in waters near Sapelo Island (Schwacke *et al.* 2012). Results from hematology and serum chemistry indicated abnormalities, most notably that 26% of sampled dolphins were anemic. ~~Also,~~The dolphins also showed low levels of thyroid~~thryoid~~ hormone, and thyroid hormones negatively correlated with PCB concentration measured in blubber. In addition, a reduction in innate and acquired immune response was found. T-lymphocyte proliferation and indices of innate immunity decreased with PCB concentration measured in blubber, indicating increased vulnerability to infectious disease. The high levels of PCBs recorded in dolphins from this stock, despite their relatively pristine environment, along with demonstrated PCB-related health effects, raise concern for the long-term health and viability of the stock. ~~Studies of the distribution and health of bottlenose dolphins in this area are ongoing (Sanger *et al.* 2008; Schwacke, pers. comm.).~~

Illegal feeding or provisioning of wild common bottlenose dolphins has been documented in Georgia, particularly near Brunswick and Savannah (Wu 2013; Kovacs and Cox 2014; Perrtree *et al.* 2014~~; Wu 2013~~), which are just south and north of the CGES Stock area, respectively. Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter the ~~natural~~ behavior and increase the risk of injury or death to wild dolphins. Dolphins in estuarine waters near Savannah recently showed the highest rate of begging behavior reported from any study site worldwide (Perrtree *et al.* 2014). There are links between provisioning wild dolphins, dolphin depredation of recreational fishing gear, begging behavior, and associated entanglement and ingestion of gear (Powell and Wells 2011; Christiansen *et al.* 2016; Hazelkorn *et al.* 2016; Powell *et al.* 2018).

STATUS OF STOCK

Common bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act, and the CGES Stock is not a strategic stock under the MMPA. The documented mean annual human-caused mortality for this stock for 2016–2020 was 0.4. 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). 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 optimum sustainable population is unknown. There are insufficient data to determine population trends for this stock. ~~However, because the abundance of the CGES 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 this stock is 1.9, and the zero mortality rate goal, 10% of PBR, is 0.2. There were no documented human-caused mortalities or serious injuries to this stock during 2009 – 2013. However, 2 recent entanglements (non-serious injuries) and entanglements in prior years in both commercial and recreational crab trap/pot fisheries have been documented. While the impact of crab trap/pot fisheries on estuarine bottlenose dolphins is currently unknown, it has been shown previously to be considerable in the similar Charleston Estuarine System Stock area (Burdett and McFee 2004). Therefore, 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.~~

REFERENCES CITED

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

Balmer, B.C., L.H. Schwacke, R.S. Wells, R.C. George, J. Hoguet, J.R. Kucklick, S.M. Lane, A. Martinez, W.A. McLellan, P.E. Rosel, T.K. Rowles, K. Sparks, T. Speakman, E.S. Zolman and D.A. Pabst. 2011. Relationship between persistent organic pollutants (POPs) and ranging patterns in common bottlenose dolphins (*Tursiops truncatus*) from coastal Georgia, USA. Sci. Total Environ. 409:2094–2101.

Balmer, B.C., L.H. Schwacke, R.S. Wells, J.D. Adams, R.C. George, S.M. Lane, W.A. McLellan, P.E. Rosel, K. Sparks, T. Speakman, E.S. Zolman and D.A. Pabst. 2013. Comparison of abundance and habitat usage for common bottlenose dolphins between sites exposed to differential anthropogenic stressors within the estuaries of southern Georgia, U.S.A. Mar. Mamm. Sci. 29:E114–135.

Barlow, J., S.L. Schwartz, T.C. Eagle and P.R. Wade. 1995. U. S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background and Summary of the 1995 Assessments. NOAA Tech. Memo. NMFS-OPR-6. 73 pp.

~~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.~~

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112:1–23.

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

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

Christiansen, F., K.A. McHugh, L. Bejder, E.M. Siegal, D. Lusseau, E.B. McCabe, G. Lovewell, R.S. Wells. 2016. Food provisioning increases the risk of injury in a long-lived marine top predator. R. Soc. open sci. 3: 160560.

De Swart, R.L., P.S. Ross, J.G. Vos and A.D.M.E. Osterhaus. 1996. Impaired immunity in harbour seals (*Phoca vitulina*) exposed to bioaccumulated environmental contaminants: Review of a long-term study. Environ. Health Perspect. 104: 823-828. EPA. 2008. http://www.epa.gov/region4/waste/npl/index.htm.

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

Hazelkorn, R.A., B.A. Schulte and T.M. Cox. 2016. Persistent effects of begging on common bottlenose dolphin (*Tursiops truncatus*) behavior in an estuarine population. Aquat. Mamm. 42(4):531–541.

Kannan, K., A.L. Blankenship, P.D. Jones and J.P. Giesy. 2000. Toxicity reference values for the toxic effects of polychlorinated biphenyls to aquatic mammals. Hum. Ecol. Risk Assess. 6:181–201.

Kannan, K., K.A. Maruya and S. Tanabe. 1997. Distribution and characterization of polychlorinated biphenyl congeners in soil and sediments from a Superfund site contaminated with Aroclor 1268. Environ. Sci. Technol. 31:1483–1488.

Kannan, K., H. Nakata, R. Stafford and G.R. Masson. 1998. Bioaccumulation and toxic potential of extremely hydrophobic polychlorinated biphenyl congeners in biota collected at a Superfund site contaminated with Aroclor 1268. Environ. Sci. Technol. 32:1214–1221.

Kovacs, C. and T. Cox. 2014. Quantification of interactions between common bottlenose dolphins (*Tursiops truncatus*) and a commercial shrimp trawler near Savannah, Georgia. Aquat. Mamm. 40(1):81–94.

Kucklick, J., L. Schwacke, R. Wells, A. Hohn, A. Guichard, J. Yordy, L. Hansen, E. Zolman, R. Wilson, J. Litz, D. Nowacek, T. Rowles, R. Pugh, B. Balmer, C. Sinclair and P. Rosel. 2011. Bottlenose dolphins as indicators of persistent organic pollutants in the western North Atlantic Ocean and northern Gulf of Mexico. Environ. Sci. Technol. 45:4270–4277.

Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1):107–117.

Maruya, K.A. and R.F. Lee. 1998. Aroclor 1268 and toxaphene in fish from a southeastern US estuary. Environ. Sci. Technol. 32:1069–1075.

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

~~Maze-Foley, K. and L.P. Garrison. in prep a. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2007-2011.~~

~~Maze-Foley, K. and L.P. Garrison. in prep b. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2012.~~

~~Maze-Foley, K. and L.P. Garrison. in prep c. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2013.~~

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. Fla. Sci. 68:217–226.

Morris, S.E., J.L. Zelner, D.A. Fauquier, T.K. Rowles, P.E. Rosel, F. Gulland and B.T. Grenfell. 2015. Partially observed epidemics in wildlife hosts: Modelling an outbreak of dolphin morbillivirus in the northwestern Atlantic, June 2013–2014. J. R. Soc. Interface 12:20150676.

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available at: http://www.nmfs.noaa.gov/op/pds/index.html

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18:278–290.

Perrtree, R.M., C.J. Kovacs and T.M. Cox. 2014. Standardization and application of metrics to quantify human-interaction behaviors by the bottlenose dolphin (*Tursiops* spp.). Mar. Mamm. Sci. 30(4):1320–1334.

Powell, J.R. and R.S. Wells. 2011. Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Mar. Mamm. Sci. 27(1): 111-129.

Powell, J.R., A.F. Machernis, L.K. Engleby, N.A. Farmer and T.R. Spradlin. 2018. Sixteen years later: An updated evaluation of the impacts of chronic human interactions with bottlenose dolphins (*Tursiops truncatus*) in Panama City, Florida, USA. J. Cetacean Res. Manage. 19:79–93.

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Molec. Ecol. 18:5030–5045.

Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded common bottlenose dolphins in southeastern Louisiana after the Deepwater Horizon oil spill. Endang. Species Res. 33:221–234.

~~Sanger, D., A. Blair, G. DiDonato, T. Washburn, S. Jones, R. Chapman, D. Bergquist, G. Riekerk, E. Wirth, J. Stewart, D. White, L. Vandiver, S. White and D. Whitall. 2008. Support for integrated ecosystem assessments of NOAA's National Estuarine Research Reserves System (NERRS), Volume I: The impacts of coastal development on the ecology and human well-being of tidal creek ecosystems of the US Southeast. NOAA Tech. Memo., NOS-NCCOS-82, 76 pp.~~

Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair. 2002. Probabilistic risk assessment of the reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Environ. Toxicol. Chem. 21: 2752–2764.

Schwacke, L.H., E.S. Zolman, B.C. Balmer, S. De Guise, R.C. George, J. Hoguet, A.A. Hohn, J.R. Kucklick, S. Lamb, M. Levin, J.A. Litz, W.E. McFee, N.J. Place, F.I. Townsend, R.S. Wells and T.K. Rowles. 2012. Anaemia, hypothyroidism and immune suppression associated with polychlorinated biphenyl exposure in bottlenose dolphins (*Tursiops truncatus*). Proc. R. Soc. B. 279(1726): 48–57.

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. Conserv. Genet. 6: 715–728.

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

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.

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1): 355–368.

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

Wu, C. 2013. Human and boat interactions with common bottlenose dolphins (*Tursiops truncatus*) in the waterways around Savannah, Georgia. M. Sc. thesis. Savannah State University, Savannah, Georgia. 101 pp.

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.

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*)
Southern Georgia 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 from 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 of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; 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~~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).~~

Figure 1. ***Geographic extent of the Southern Georgia Estuarine System (SGES) stock. Dashed lines denote the boundaries.***

Coastal southern Georgia contains an extensive estuarine tidal marsh system, punctuated with several river drainages. There is moderate development throughout the region, along with the largest~~r~~ industrialized area around Brunswick, Georgia. The Environmental Protection Agency has included four~~4~~ sites within the Brunswick area among the Superfund hazardous waste sites.

Balmer *et al.* (2011) conducted photo-ID studies ~~between~~from 2004 ~~and~~to 2009 in two field sites in south-central Georgia, one in the Turtle/Brunswick River estuary (TBRE) and the second north of the Altamaha River/Sound including the Sapelo Island National Estuarine Research Reserve and extending north to Sapelo Sound. Photo-ID data revealed strong site fidelity to the two regions and supported Altamaha Sound as an appropriate boundary between the two sites as 85.4% of animals identified did not cross Altamaha Sound (Balmer *et al.* 2013). Just over half the animals that did range across Altamaha Sound had low site fidelity and were believed to be members of the South Carolina/Georgia Coastal Stock.

~~Genetic analysis of mitochondrial DNA control region sequences and microsatellite markers of dolphins biopsied~~

~~in southern Georgia showed significant genetic differentiation from animals biopsied in northern Georgia and southern South Carolina estuaries as well as from animals biopsied in coastal waters >1 km from shore at the same latitude (NMFS unpublished data).~~ In addition, bottlenose dolphins in the TBRE exhibit contaminant burdens consistent with long-term fidelity to the TBRE (Pulster and Maruya 2008; Balmer *et al.* 2011; Kucklick *et al.* 2011). Analyses to determine whether multiple demographically independent populations exist within this stock have not been performed.

~~Therefore, t~~The Southern Georgia Estuarine System Stock (SGES) is bounded in the south by the Georgia/Florida border at the Cumberland River ~~out~~ through Cumberland Sound and in the north by the Altamaha River ~~out~~ through Altamaha Sound inclusive, and encompasses all estuarine waters in between, including but not limited to the Intracoastal Waterway, Hampton River, St. Andrew and Jekyll Sounds and their tributaries, St. Simons Sound and tributaries, and the TBRE system (Figure 1). Although the majority of photo-ID survey effort by Balmer *et al.* (2013) was conducted within the estuaries, opportunistic surveys extending along the coast and satellite-linked telemetry of three individuals suggested that animals within the SGES had ranging patterns that extended into the coastal waters of the TBRE. Thus, the nearshore (≤ 1km from shore) coastal waters from Altamaha Sound to Cumberland Sound are~~were~~ included in the SGES Stock boundaries. The southern boundary abuts the northern boundary of the Jacksonville Estuarine System Stock, previously defined based on photo-ID and genetic data (Caldwell 2001). The northern boundary abuts the southern boundary of the Central Georgia Estuarine System Stock, and is defined based on continuity of estuarine habitat, evidence for significantly lower contaminant levels in dolphins from the Sapleo Island area (Balmer *et al.* 2011) and a genetic discontinuity between dolphins sampled in southern Georgia and those sampled in Charleston, South Carolina (Rosel *et al.* 2009). These boundaries are subject to change upon further study of dolphin residency patterns in estuarine waters of central and northern Georgia.

POPULATION SIZE

The current total number of common bottlenose dolphins residing within the SGES Stock is unknown because previous estimates are more than 8 years old (Table 1; NMFS 2016).

Earlier abundance estimates (>8 years old)

During 2008–~~-~~2009, seasonal, mark-recapture, photo-ID surveys were conducted by Balmer *et al.* (2013) to estimate abundance in a portion of the SGES including St. Simons Sound north to and inclusive of Altamaha Sound. Estimates from winter were chosen as the best representation of the portion of resident estuarine stock in the area surveyed, and a random emigration model was chosen as the best fit based on the lowest Akaike's Information Criterion value. The estimated average abundance estimate, based on winter 2008 and winter 2009 surveys, was 194 (CV=0.05; Balmer *et al.* 2013). It is important to note this estimate covered less than half of the entire range of the SGES Stock, and therefore, the abundance estimate is negatively biased.

Minimum Population Estimate

No current information on abundance is available to calculate a minimum population estimate for the SGES Stock of common bottlenose dolphins.~~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 SGES Stock is 194 (CV=0.05). The resulting minimum population estimate is 185.~~

Current Population Trend

There are insufficient data to determine the population trends for this stock because only one estimate of population size is available.~~One abundance estimate is available for this stock, and therefore there are insufficient data to assess population trends.~~

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the SGES Stock of common bottlenose dolphins is unknown~~185~~. 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 undetermined (Table 1)~~1.9~~.

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

Nest	CV Nest	Nmin	Fr	Rmax	PBR
Unknown	-	Unknown	0.5	0.04	Undetermined

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the SGES Stock during 2016–2020~~2009-2013~~ 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 0.1. No additional mortality or serious injury was documented from other human-caused sources. The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 0.1 (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).~~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

The commercial fishery that ~~This stock~~interacts, or has the potential to interact, with this stock, is~~ with~~ the Category II commercial Atlantic blue crab trap/pot fishery~~ (Appendix III)~~. 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.

Trap/Pot

During 2016–2020, there was one documented entanglement interaction of a common bottlenose dolphin in the SGES Stock area in commercial blue crab trap/pot gear. The interaction occurred during 2016 and the animal was released alive, but 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 in prep). The CBD case was prorated based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison in prep) and was included in the annual human-caused mortality and serious injury total for this stock (see Table 2), and 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 crab trap/pot fisheries. The documented interaction in this gear represents a minimum known count of interactions in the last five years.

~~During 2009-2013 there were no documented interactions with crab trap/pot gear in the SGES area. The most recent documented interaction is from 2005. Since 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

During 2016–2020 within the SGES area, there were two documented entanglements of common bottlenose dolphins in other gear types. In 2016, an animal was released alive following entanglement in a research seine, and this animal was considered not seriously injured (Maze-Foley and Garrison in prep). In 2017 an animal was released alive following entanglement in marine debris (Balmer *et al.* 2019), and it was considered not seriously injured following mitigation efforts (the initial determination was seriously injured; Maze-Foley and Garrison in prep). Both of these entanglements of live animals were included within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021).

All mortalities and serious injuries from known sources for the SGES Stock are summarized in Table 2.

Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (Tursiops truncatus) of the Southern Georgia 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**
Commercial Blue Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	0.5*a
Mean Annual Mortality due to commercial fisheries (2016–2020)			**0.1**	
Mean Annual Mortality due to other takes (2016–2020)			**0***	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)			**0.1**	

a. 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 in prep).

Strandings

During 2016–2020, 19 common bottlenose dolphins were reported stranded within the SGES 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 three of the strandings. No evidence of human interaction was detected for four strandings, and for the remaining 12 strandings, it could not be determined if there was evidence of human interaction. Human interactions included an entanglement with commercial blue crab trap/pot gear, a research seine, and marine debris. 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 SGES Stock area has been affected by one unusual mortality event (UME) during the most recent 15 years. A 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). During 2015, Balmer *et al.* (2018) conducted a telemetry and health assessment study during which 19 common bottlenose dolphins were captured, satellite-linked tags were applied, and dolphins were tested for antibodies to dolphin morbillivirus (DMV). Using telemetry data, dolphins were classified into three ranging patterns referred to as estuary, sound and coastal. The findings of Balmer *et al.* (2018) supported those of Morris *et al.* (2015) and suggested that coastal animals, likely members of the South Carolina/Georgia Coastal Stock, were more exposed to DMV (based on DMV antibody titers) compared to animals from the SGES Stock (sound and estuary animals).

~~From 2009 to 2013, 31 common bottlenose dolphins were reported stranded within the SGES (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11June 2014). It could not be determined if there was evidence of human interaction for 28 of these strandings. For the remaining 3 dolphins, no evidence of human interaction was detected. 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.~~

~~An Unusual Mortality Event (UME) was declared in the summer of 2013 for the mid-Atlantic coast from New York to Brevard County, Florida. Beginning in July 2013, 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 and work continues to determine the effect of this event on all bottlenose dolphin stocks in the Atlantic.~~

Table 3. Common bottlenose dolphin strandings occurring in the Southern Georgia 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**
Southern Georgia Estuarine System Stock	Total Stranded	5	7	3	3	1	19
	HI--Yes	2a	1b	0	0	0	3
	HI--No	1	2	1	0	0	4
	HI--CBD	2	4	2	3	1	12

a. Includes 1 entanglement in a research seine (released alive, not seriously injured) and 1 fisheries interaction, an entanglement interaction with commercial blue crab trap/pot gear (released alive, CBD if seriously injured).

b. Includes 1 entanglement in marine debris (released alive, not seriously injured).

HABITAT ISSUES

A portion of the stock's range is highly industrialized, and the Environmental Protection Agency has included four~~4~~ sites within the Brunswick area as Superfund hazardous waste sites. Specifically, the LCP Chemicals Site contaminated soils, groundwater and adjacent marsh with mercury and polychlorinated biphenyls (PCBs). Mean total polychlorinated biphenyl (PCB) concentrations from dolphins biopsied in the TBRE (Pulster and Maruya 2008; Sanger *et al.* 2008) were significantly higher than dolphins sampled in other areas of the world including other inshore estuarine waters along the Southeast coast of the United States, including the Gulf of Mexico (Schwacke *et al.* 2002; Hansen *et al.* 2004; Litz 2007; Balmer *et al.* 2011; Kucklick *et al.* 2011). PCB congeners measured in tissues of dolphins biopsied in the TBRE system were enriched in highly chlorinated homologs consistent with Aroclor 1268 (Pulster and Maruya 2008; Sanger *et al.* 2008, Balmer *et al.* 2011; Kucklick *et al.* 2011). The TBRE area is known to be contaminated with this specific PCB mixture in soil and sediments, and the transport of these contaminants into the food web through invertebrate and vertebrate fauna has been documented (Kannan *et al.* 1997; Kannan *et al.* 1998; Maruya and Lee 1998).

Studies have suggested an increased risk of detrimental effects on reproduction and endocrine and immune system function for marine mammals in relation to tissue concentrations of PCBs (De Swart *et al.* 1996; Kannan *et al.* 2000; Schwacke *et al.* 2002). PCB-related health effects on bottlenose dolphins along the Georgia coast were examined through a capture-release health assessment conducted during 2009 in the TBRE and in waters near Sapelo Island (Schwacke *et al.* 2012). Results from hematology and serum chemistry indicated abnormalities, most notably that 26% of sampled dolphins were anemic. Also, dolphins showed low levels of thyr~~y~~oid hormone, and thyroid hormones negatively correlated with PCB concentration measured in blubber. In addition, a reduction in innate and acquired immune response was found. T-lymphocyte proliferation and indices of innate immunity decreased with PCB concentration measured in blubber, indicating increased vulnerability to infectious disease. Overall, the results plainly showed that bottlenose dolphins are susceptible to PCB-related health effects (Schwacke *et al.* 2012). Thus, the high levels of PCBs recorded in dolphins from this stock, along with demonstrated PCB-related health effects, raise concern for the long-term health and viability of the stock. ~~Studies of the distribution and health of bottlenose dolphins in this area are ongoing (Sanger *et al.* 2008; Schwacke, pers. comm.).~~

In 2017, a dolphin with long-term site fidelity to the SGES area that was entangled in marine debris was captured for disentanglement (Balmer *et al.* 2019). During the disentanglement capture event, samples were also collected to assess the animal's health. Health results showed the animal to have high levels of site-specific contaminants, PCBs and Aroclor 1268, and to suffer from anemia. Balmer *et al.* (2019) note the possibility the chronic entanglement and associated blood loss could have played a role in the anemia; however, it is likely the anemia was a result of chronic PCB exposure (see Schwacke *et al.* 2012).

Illegal feeding or provisioning of wild bottlenose dolphins has been documented in Georgia, particularly near Brunswick and Savannah (Wu 2013; Kovacs and Cox 2014; Perrtree *et al.* 2014~~; Wu 2013~~). Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter the ~~natural~~ behavior and increase the risk of injury or death to wild dolphins. There are links between provisioning wild dolphins, dolphin depredation of recreational fishing gear, begging behavior, and associated entanglement and ingestion of gear (Powell and Wells 2011; Christiansen *et al.* 2016; Hazelkorn *et al.* 2016; Powell *et al.* 2018).

STATUS OF STOCK

Common bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act, and the SGES Stock is not a strategic stock under the MMPA. The documented mean annual human-caused mortality for this stock for 2016–2020 was 0.1. 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). 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 optimum sustainable population is unknown. There are insufficient data to determine population trends for this stock.

Although this stock does not meet the criteria to qualify as strategic (NMFS 2016), NMFS has concerns for this stock because the abundance of the stock is currently unknown but likely small given the available previous estimate, the number of common bottlenose dolphin deaths associated with fisheries interactions, and detrimental impacts of high pollutant burdens, which may be a significant issue for this stock due to the high mean total PCB concentrations found in the blubber of animals in this region.

~~However, because the abundance of the SGES 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 this stock is 1.9 and so the zero mortality rate goal, 10% of PBR, is 0.2. There have been no documented human-caused mortalities to this stock during 2009 – 2013. Entanglements in both commercial and recreational crab pot fisheries have been documented in prior years, and while the impact of crab trap/pot fisheries on estuarine bottlenose dolphins is currently unknown, it has been shown previously to be considerable in the similar Charleston Estuarine System Stock area (Burdett and McFee 2004). Therefore, documented mortalities must be considered minimum estimates of total fishery-related mortality. Detrimental impacts of high pollutant burdens may be a significant issue for this stock due to the high mean total polychlorinated biphenyl (PCB) concentrations found in the blubber of animals in this region. 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.~~

REFERENCES CITED

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

Balmer, B.C., L.H. Schwacke, R.S. Wells, R.C. George, J. Hoguet, J.R. Kucklick, S.M. Lane, A. Martinez, W.A. McLellan, P.E. Rosel, T.K. Rowles, K. Sparks, T. Speakman, E.S. Zolman and D.A. Pabst. 2011. Relationship between persistent organic pollutants (POPs) and ranging patterns in common bottlenose dolphins (*Tursiops truncatus*) from coastal Georgia, USA. Sci. Total Environ. 409: 2094–2101.

Balmer, B.C., L.H. Schwacke, R.S. Wells, J.D. Adams, R.C. George, S.M. Lane, W.A. McLellan, P.E. Rosel, K. Sparks, T. Speakman, E.S. Zolman and D.A. Pabst. 2013. Comparison of abundance and habitat usage for common bottlenose dolphins between sites exposed to differential anthropogenic stressors within the estuaries of southern Georgia, U.S.A. Mar. Mamm. Sci. 29(2): E114–E135.

Balmer, B., E. Zolman, T. Rowles, C. Smith, F. Townsend, D. Fauquier, C. George, T. Goldstein, L. Hansen, B. Quigley, W. McFee, J. Morey, P. Rosel, J. Saliki, T. Speakman and L. Schwacke. 2018. Ranging patterns, spatial overlap, and association with dolphin morbillivirus exposure in common bottlenose dolphins (*Tursiops truncatus*) along the Georgia, USA coast. Ecol. Evol. 2018:00:1–15.

Balmer, B., E. Zolman, J. Bolton, D. Fauquier, E. Fougeres, R.C. George, T. Goldstein, M. Gowen, T. Kolkmeyer, C. Le-Bert, B. Mase, T. Norton, J. Peterson, T. Rowles, J. Saliki and G. Ylitalo. 2019. Ranging patterns and exposure to cumulative stressors of a *Tursiops truncatus* (common bottlenose dolphin) in Georgia. Southeast. Nat. 18(1): N1–N9.

Barlow, J., S.L. Schwartz, T.C. Eagle and P.R. Wade. 1995. U. S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background and Summary of the 1995 Assessments. NOAA Technical Memorandum NMFS-OPR-6. 73 pp.

~~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.~~

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112: 1–23.

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

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

Christiansen, F., K.A. McHugh, L. Bejder, E.M. Siegal, D. Lusseau, E.B. McCabe, G. Lovewell, R.S. Wells. 2016. Food provisioning increases the risk of injury in a long-lived marine top predator. R. Soc. open sci. 3: 160560.

De Swart, R.L., P.S. Ross, J.G. Vos and A.D.M.E. Osterhaus. 1996. Impaired immunity in harbour seals (*Phoca vitulina*) exposed to bioaccumulated environmental contaminants: Review of a long-term study. Environ. Health Perspect. 104: 823–828. EPA. 2008. http://www.epa.gov/region4/waste/npl/index.htm.

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

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

Hazelkorn, R.A., B.A. Schulte and T.M. Cox. 2016. Persistent effects of begging on common bottlenose dolphin (*Tursiops truncatus*) behavior in an estuarine population. Aquat. Mamm. 42(4):531–541.

Kannan, K., A.L. Blankenship, P.D. Jones and J.P. Giesy. 2000. Toxicity reference values for the toxic effects of polychlorinated biphenyls to aquatic mammals. Hum. Ecol. Risk Assess. 6:181–201.

Kannan, K., K.A. Maruya and S. Tanabe. 1997. Distribution and characterization of polychlorinated biphenyl congeners in soil and sediments from a Superfund site contaminated with Aroclor 1268. Environ. Sci. Technol. 31:1483–1488.

Kannan, K., H. Nakata, R. Stafford and G.R. Masson. 1998. Bioaccumulation and toxic potential of extremely hydrophobic polychlorinated biphenyl congeners in biota collected at a Superfund site contaminated with Aroclor 1268. Environ. Sci. Technol. 32:1214–1221.

Kovacs, C. and T. Cox. 2014. Quantification of interactions between common bottlenose dolphins (*Tursiops truncatus*) and a commercial shrimp trawler near Savannah, Georgia. Aquat. Mamm. 40(1):81–94.

Kucklick, J., L. Schwacke, R. Wells, A. Hohn, A. Guichard, J. Yordy, L. Hansen, E. Zolman, R. Wilson, J. Litz, D. Nowacek, T. Rowles, R. Pugh, B. Balmer, C. Sinclair and P. Rosel. 2011. Bottlenose dolphins as indicators of persistent organic pollutants in the western North Atlantic Ocean and northern Gulf of Mexico. Environ. Sci. Technol. 45:4270–4277.

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

Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1):107–117.

Maruya, K.A. and R.F. Lee. 1998. Aroclor 1268 and toxaphene in fish from a southeastern US estuary. Environ. Sci. Technol. 32:1069–1075.

Maze-Foley, K. and L.P. Garrison. in prep. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2022-XX. XX pp.

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

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. Fla. Sci. 68:217–226.

Morris, S.E., J.L. Zelner, D.A. Fauquier, T.K. Rowles, P.E. Rosel, F. Gulland and B.T. Grenfell. 2015. Partially observed epidemics in wildlife hosts: Modelling an outbreak of dolphin morbillivirus in the northwestern Atlantic, June 2013–2014. J. R. Soc. Interface 12:20150676.

NMFS 2012. Process for distinguishing serious from non-serious injury of marine mammals: Process for injury determinations. National Marine Fisheries Service Policy Directive PD 02-038-01. January 2012. Available from: http://www.nmfs.noaa.gov/pr/laws/mmpa/policies.htm [Federal Register Notice, Vol. 77, No. 14, page 3233, January 23, 2012]

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available at: http://www.nmfs.noaa.gov/op/pds/index.html

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18:278–290.

Perrtree, R.M., C.J. Kovacs and T.M. Cox. 2014. Standardization and application of metrics to quantify human-interaction behaviors by the bottlenose dolphin (*Tursiops* spp.). Mar. Mamm. Sci. 30(4):1320–1334.

Powell, J.R. and R.S. Wells. 2011. Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Mar. Mamm. Sci. 27(1):111–129.

Powell, J.R., A.F. Machernis, L.K. Engleby, N.A. Farmer and T.R. Spradlin. 2018. Sixteen years later: An updated evaluation of the impacts of chronic human interactions with bottlenose dolphins (*Tursiops truncatus*) in Panama City, Florida, USA. J. Cetacean Res. Manage. 19:79–93.

Pulster, E.L. and K.A. Maruya. 2008. Geographic specificity of Aroclor 1268 in bottlenose dolphins (*Tursiops truncatus*) frequenting the Turtle/Brunswick River estuary, Georgia (USA). Sci. Total Environ. 393:~~-~~367–~~-~~375.

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Molec. Ecol. 18:~~-~~5030–5045.

Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded common bottlenose dolphins in southeastern Louisiana after the Deepwater Horizon oil spill. Endang. Species Res. 33:221–234.

Sanger, D., A. Blair, G. DiDonato, T. Washburn, S. Jones, R. Chapman, D. Bergquist, G. Riekerk, E. Wirth, J. Stewart, D. White, L. Vandiver, S. White and D. Whitall. 2008. Support for integrated ecosystem assessments of NOAA's National Estuarine Research Reserves System (NERRS), Volume I: The impacts of coastal development on the ecology and human well-being of tidal creek ecosystems of the US Southeast. NOAA Tech. Memo., NOS-NCCOS-82~~,~~. 76 pp.

Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair. 2002. Probabilistic risk assessment of the reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Environ. Toxicol. Chem. 21:~~-~~2752–~~-~~2764.

Schwacke, L.H., E.S. Zolman, B.C. Balmer, S. De Guise, R.C. George, J. Hoguet, A.A. Hohn, J.R. Kucklick, S. Lamb, M. Levin, J.A. Litz, W.E. McFee, N.J. Place, F.I. Townsend, R.S. Wells and T.K. Rowles. 2012. Anaemia, hypothyroidism and immune suppression associated with polychlorinated biphenyl exposure in bottlenose dolphins (*Tursiops truncatus*). Proc. R. Soc. B. 279(1726):~~-~~48–~~-~~57.

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. Conserv. Genet. 6:~~-~~715–~~-~~728.

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

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1):~~-~~355–~~-~~368.

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

Wu, C. 2013. Human and boat interactions with common bottlenose dolphins (*Tursiops truncatus*) in the waterways around Savannah, Georgia. M. Sc. thesis. Savannah State University, Savannah, Georgia. 101 pp.

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.

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*)
Jacksonville 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 of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; 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~~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).~~

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

The estuarine habitat around Jacksonville, Florida, is composed of several large brackish rivers, including St. Mary's, Amelia, Nassau, Fort George and St. Johns River (Figure 1). The St. Johns River is a deep, swift moving river with heavy boat and shipping activity (Caldwell 2001). The remainder of the area is made up of tidal marshes and riverine systems averaging 2 m in depth over sand, mud or oyster beds, and is bisected by the Intracoastal Waterway.

Caldwell (2001; 2016a,b) investigated the social structure of common bottlenose dolphins inhabiting the estuarine waters between the St. Mary's River and Jacksonville Beach, Florida, using photo-ID and behavioral data obtained from December 1994 through December 1997. Three behaviorally different communities were identified during this study, namely the estuarine waters north of St. Johns River (termed the Northern area), the estuarine waters south of St. Johns River (the Southern area) and the coastal area, all of which differed in density, habitat fidelity and social affiliation patterns. Caldwell (2001; 2016b) found that dolphins inhabiting the Northern area were the most isolated and demonstrated ~~, with 96% of the groups observed containing dolphins that had been photographically identified only in this area, demonstrating~~ strong year-round site fidelity. Cluster analyses suggested that dolphins using the Northern area did not socialize with those using the Southern area. In the Southern area, 78% of the groups were photographed only in this region ~~(Caldwell 2001). However,~~ but these dolphins moved~~migrated~~ into and out of the Jacksonville area each year, returning ~~to the area~~ during three~~3~~ consecutive summers, suggesting the Southern area dolphins may show summer site fidelity as opposed to the year-round fidelity demonstrated in the Northern area (Caldwell 2001; 2016b). Caldwell (2001; 2016b) reported~~found~~ that dolphins found in the coastal areas were highly mobile, had fluid social affiliations, were not sighted more than eight~~8~~ times over the entire study and showed no long-term (> 4 months) site fidelity. Three of these dolphins were also sighted off South Carolina, behind shrimp boats. These coastal dolphins are thus considered to be members of a~~the~~ coastal ~~morphotype~~ stock~~s~~. Caldwell (2001) also examined genetic differentiation among the Northern, Southern and coastal areas of the study site using mitochondrial DNA sequences and microsatellite data. Both mitochondrial DNA haplotype and microsatellite allele frequencies differed significantly between the Northern and Southern sampling areas. Differentiation between the Southern sampling area and the coast was lower, but still significant. Rosel *et al.* (2009) also found evidence for genetic subdivision within samples collected in the Jacksonville region. These genetic data are in line with the behavioral analyses. However, sample sizes were small for these estuarine regions (n≤ 25) and genetic analyses did not account for the high number of closely related individuals within the dataset. Finally, Mazzoil *et al.* (2020) using photo-ID data further corroborated the isolation and site-fidelity of the dolphins in the northern portion of the stock area, illustrating that this pattern has temporal stability. They recommended Florida estuarine waters north of the St. Johns River (the northern Jacksonville Estuarine System (JES) stock region) be split from the JES Stock and made a separate stock whose northern border remains undetermined. These data combined suggest it is plausible there are multiple demographically independent populations of common bottlenose dolphins within the stock area. Further analyses are necessary to augment the genetic analyses, to explore the northern stock boundary of the JES Stock, and to determine whether the dolphins in the northern area exhibit demographic independence.

Gubbins *et al.* (2003) identified oscillating abundance year round for dolphins within the estuarine waters of this area, with low numbers reported in January and December. There was a positive correlation between dolphin abundance and water temperature, with peak numbers seen when water temperatures rose above 16°C.

The ~~Jacksonville Estuarine System (~~JES~~)~~ Stock has been defined as a separate estuarine stock based on ~~primarily by~~ the results of these photo-ID and genetic studies. It is bounded in the north by the Florida/Georgia border at Cumberland Sound, abutting the southern border of the Southern Georgia Estuarine System Stock, and extends south to Jacksonville Beach, Florida. Despite the strong fidelity to the Northern and Southern areas observed by Caldwell (2001; 2016b), some dolphins were photographed outside their preferred areas, supporting the proposal to include both these areas within the boundaries of the JES Stock. Mazzoil *et al.* (2020) identified dolphins from the southern portion of the JES Stock area utilizing the Intracoastal Waterway further south and suggested the southern boundary of the stock be extended to include estuarine waters as far south as the St. Augustine River inlet. Future analyses may provide additional information on the importance of the Southern area to the resident stock, and thus the inclusion of both areas in this stock boundary may be modified with additional data or further analyses.

Dolphins residing within estuaries south of this stock down to the northern boundary of the Indian River Lagoon Estuarine System Stock (IRLES) are currently not included in any Stock Assessment Report. There are insufficient data to determine whether animals south of the JES Stock exhibit affiliation to the JES Stock, the IRLES Stock to the south or are simply transient animals associated with coastal stocks. Further research is needed to establish affinities of dolphins in this region. It should be noted that during 2016–2020~~2009-2013~~, there were 29~~32~~ stranded common bottlenose dolphins in this region in estuarine waters. There was evidence of human interaction for four of the strandings, including two interactions with hook and line fishing gear, one entanglement in commercial blue crab trap/pot gear, and one entanglement in unidentified rope/line. The two interactions with hook and line gear were both mortalities for which evidence suggested the hook and line gear contributed to cause of death. The entanglement in commercial blue crab trap/pot gear was a live release for which it could not be determined if the animal was seriously injured following mitigation efforts (initial determination was seriously injured; Maze-Foley and Garrison in prep). The entanglement in unidentified rope/line involved a live animal that shed the gear on its own and was considered not seriously injured (Maze-Foley and Garrison in prep). ~~, including 3 interactions with hook and line fishing gear (1 mortality, 1 serious injury, 1 live release without serious injury), and 2 entanglements in commercial blue crab trap/pot gear (1 mortality and 1 live release without serious injury) (Maze-Foley and Garrison in prep a,b) .~~ In addition to animals included in the stranding database, in estuarine waters south of JES there was one~~were 3~~ at-sea observation~~s~~ of a dolphin~~s~~ entangled in commercial blue crab trap/pot gear. The dolphin shed the gear on its own and was considered not seriously injured~~hook and line gear, crab trap/pot gear and thick line. All 3 dolphins were considered not seriously injured~~ (Maze-Foley and Garrison in prep~~ a,b~~).

POPULATION SIZE

The total number of common bottlenose dolphins residing within the JES Stock is unknown because previous estimates are ~~greater~~more than 8 years old (Table 1; NMFS 2016). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates greater than 8 years old are deemed unreliable.~~

Earlier abundance estimates (>8 years old)

Data collected by Caldwell (2001; 2016a,b) were incorporated into a larger study that used mark-recapture analyses to calculate abundance in four~~4~~ estuarine areas along the eastern U.S. coast (Gubbins *et al.* 2003). Sighting records collected only from May through October were used, as this limited time period was determined to reduce the possibility of violating the mark-recapture model's assumption of geographic closure and mark retention. Based on photo-ID data from 1994 to 1997, 334 individually identified dolphins were observed (Gubbins *et al.* 2003), which included an unspecified number of seasonal residents and transients. Mark-recapture analyses included all the 334 individually identifiable dolphins, and the population size for the JES Stock was calculated to be 412 residents (CV=0.06; Gubbins *et al.* 2003). This was an overestimate of the stock abundance in the area covered by the study because it included non-resident and seasonally resident dolphins. Caldwell (2001; 2016b) indicated that 122 dolphins were resighted at least 10 times in the JES, with 33 individuals observed primarily in the Northern area, and 89 individuals reported to use the Southern area.

Minimum Population Estimate

No current information on abundance is available to calculate a minimum population estimate for the JES Stock of common bottlenose dolphins.~~The current minimum population estimate for this stock of common bottlenose dolphins is unknown (Table 1). 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

One abundance estimate is available for this stock, and therefore there are insufficient data to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the JES Stock is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5 because this stock is of unknown status. PBR for the JES Stock of common bottlenose dolphins is unknown (Table 1). ~~PBR is unknown for this stock.~~

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

Nest	CV Nest	Nmin	Fr	Rmax	PBR
Unknown	-	Unknown	0.5	0.04	Unknown

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the JES Stock during 2016–2020~~2009–2013~~ is unknown ~~because this stock is known to interact with unobserved fisheries (see below)~~. The mean annual fishery-related mortality and serious injury during 2016–2020 based on strandings and at-sea observations identified as fishery-related was 2.0. No additional mortality or serious injury was documented from other human-caused sources. The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 2.0 (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 the only data 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, 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), and 5) strandings with evidence of fishery-related interactions occurred in waters south of the JES Stock boundary that are not included within any stock, and some or all of those strandings could have been part of this stock (see Stock Definition and Geographic Range section).

~~The mean annual fishery-related mortality and serious injury for strandings and at-sea observations identified as fishery-caused was 1.2. No additional mortality or serious injury was documented from other human-caused actions. The minimum total mean annual human-caused mortality and serious injury for this stock during 2009-2013 was 1.2.~~

Fishery Information

~~The commercial fisheries that interact, or that potentially could interact, with this stock are the Category II Atlantic blue crab trap/pot; and Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot fisheries; and the Category III Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fishery (Appendix III).~~There are three commercial fisheries that interact, or that potentially could interact, with this stock. These include two Category II fisheries (Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot and Atlantic blue crab trap/pot) and one Category III fishery (Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line)). 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.

~~Crab~~ Trap/Pot

~~Between 2009 and 2013, 7 strandings within the JES area displayed evidence of interaction with a trap/pot fishery (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11 June 2014). Three carcasses were entangled in crab trap gear (identified as commercial blue crab trap gear in 2 cases and unidentified trap/pot gear in the third), and 4 live animals were observed entangled in commercial blue crab trap line and buoys. One of the live animals was determined to be seriously injured and 3 were determined to be not seriously injured (Maze-Foley and Garrison in prep a,b,c). 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.~~

During 2016–2020 there were eight documented entanglement interactions of common bottlenose dolphins in the JES area with trap/pot fisheries. During 2016 there was one mortality and one animal disentangled from commercial blue crab trap/pot gear and released alive. 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 in prep). During 2017 there were three live animals entangled in commercial blue crab trap/pot gear for two cases and unidentified trap/pot gear in one case. For one case, the animal disentangled itself and was not considered seriously injured. For the remaining two cases, both animals were disentangled, and one was considered seriously injured post-mitigation (commercial blue crab trap/pot gear), and for the other case it could not be determined whether the animal was seriously injured following mitigation efforts (the initial determination was seriously injured; Maze-Foley and Garrison in prep). During 2018 there was one mortality in commercial blue crab trap/pot gear. During 2020 there were two live animals disentangled from commercial blue crab trap/pot gear. One animal was considered seriously injured, and for the second animal, it could not be determined whether the animal was seriously injured following mitigation efforts (the initial determination was seriously injured (Maze-Foley and Garrison in prep). The two mortalities, two live entanglements that were seriously injured, and three live entanglements that were CBD for serious injury (CBD cases were prorated based on previous assignable injury events; NMFS 2012; Maze-Foley and Garrison in prep) 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.

Hook and Line (Rod and Reel)

~~During 2009-2013, 1 live animal was documented entangled in hook and line gear and debris within the JES area, and this animal was considered seriously injured (Maze-Foley and Garrison in prep b). This animal was included in the stranding database and in the stranding totals presented in Table 1. It should be noted that, in general, it cannot be determined if hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no systematic observer program.~~

During 2016–2020 within the JES area, there were five documented interactions within the stranding data of common bottlenose dolphins entangled in or with ingested hook and line fishing gear. During 2016, there were two mortalities and one live animal considered seriously injured. For one of the mortalities, it could not be determined whether the hook and line gear interaction contributed to cause of death, and for the second mortality, available evidence suggested the hook and line gear did not contribute to cause of death. During 2017, there was one mortality and one animal considered seriously injured. For the mortality, evidence suggested the hook and line gear did not contribute to cause of death. The two serious injuries are included in the annual human-caused mortality and serious injury total for this stock (Table 2; Maze-Foley and Garrison in prep). All of these cases were included in the stranding database and in the stranding totals presented in Table 3 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021).

In addition to the interactions documented within the stranding data, two live common bottlenose dolphins were observed at-sea (in 2016 and 2017) entangled in hook and line fishing gear. Both dolphins were considered seriously injured, and are also included in the annual human-caused mortality and serious injury total for this stock (Table 2; Maze-Foley and Garrison in prep).

It should be noted that, in general, it cannot be determined if rod and reel hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no observer program. The documented interactions in this gear represent a minimum known count of interactions in the last five years.

Other Mortality

There were no additional documented mortalities or serious injuries besides those described in the fisheries sections above. All mortalities and serious injuries from known sources for the JES Stock are summarized in Table 2.

Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (Tursiops truncatus) of the Jacksonville 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

Commercial Blue Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	5.5*a
Unidentified Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	0.5*b
Hook and Line	2016–2020	Stranding Data and At-Sea Observations	NA	4
Mean Annual Mortality due to commercial fisheries (2016–2020)			**2.0**	
Mean Annual Mortality due to other takes (2016–2020)			**0**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)			**2.0**	

a. Includes two cases of CBD which were prorated based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison in prep). There was one case of a non-calf entanglement in which the post-mitigation determination was CBD. The CBD was prorated as 0.46 (rounded to 0.5). There was one case of a calf entanglement in which the post-mitigation determination was a CBD, and this case was prorated as a serious injury (1 serious injury). The two CBD cases were therefore prorated as 1.5 serious injuries.

b. One case of CBD which was prorated based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison in prep). There was one non-calf entanglement in which the post-mitigation determination was CBD. The CBD was prorated as 0.46 (rounded to 0.5).

Strandings

~~During 2009-2013, 71 strandings were documented within the JES area, including 18 strandings with evidence of a human interaction. Human interactions were from numerous sources, including the 7 crab trap/pot interactions and 1 hook and line gear interaction noted above, as well as entanglement in an Aerobie frisbee, and also evidence of 3 boat collisions (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11 June 2014). For 7 strandings, no evidence of human interactions was found, and for 46 strandings, it could not be determined if there was evidence of human interactions.~~

During 2016–2020, 55 common bottlenose dolphins were reported stranded within the JES 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 19 of the strandings. For the remaining 36 strandings, it could not be determined if there was evidence of human interaction. Thirteen human interactions were from entanglements with trap/pot gear and hook and line gear as described above, and there was also evidence of vessel strike for two animals (one was also entangled in trap/pot gear). 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 ~~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; 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.

~~In addition to animals included in the stranding database, in 2013 there was an at-sea observation in the JES area of a dolphin entangled in unidentified fishing gear, and this dolphin was determined to be seriously injured (Maze-Foley and Garrison in prep c).~~

The JES Stock has been affected by two unusual mortality events (UMEs) during the past 15 years.~~An Unusual Mortality Event (UME)~~ A UME was declared for the St. Johns River area during May–~~-~~September 2010, including 14 strandings assigned to the JES Stock and ~~4~~four strandings within estuaries to the south not currently included in any stock assessment report. The cause of this UME ~~is~~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).~~A UME was declared in the summer of 2013 for the mid-Atlantic coast from New York to Brevard County, Florida.~~ 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).~~Beginning in July 2013, common bottlenose dolphins have been stranding at elevated rates. The total number of stranded common 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, several confirmed morbillivirus positive animals ~~have been~~were recovered from within the JES Stock area. ~~The UME is still ongoing and work continues to determine the effect of this event on all common bottlenose dolphin stocks in the Atlantic.~~

Table 3. Common bottlenose dolphin strandings occurring in the Jacksonville 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**
Jacksonville Estuarine System Stock	Total Stranded	11	10	11	15	8	55
	HI--Yes	7a	6b	1c	3d	2e	19
	HI--No	0	0	0	0	0	0
	HI--CBD	4	4	10	12	6	36

a. Includes 6 fisheries interactions (FIs), including 2 entanglement interactions with commercial blue crab trap/pot gear (1 mortality; 1 released alive, CBD if seriously injured), and 3 entanglement interactions with hook and line gear (2 mortalities; 1 released alive, seriously injured). In addition to the FIs, it also includes 1 entanglement in unidentified rope/line.

b. Includes 5 FIs, including 2 entanglement interactions with hook and line gear (1 mortality; 1 released alive, seriously injured), and 3 live entanglements in blue crab trap/pot gear (confirmed to be commercial gear in 2 cases - 1 seriously injured, 1 not seriously injured; and 1 CBD if seriously injured).

c. Includes 1 FI which was an entanglement interaction with commercial blue crab trap/pot gear (mortality, 3 sets of gear involved); this animal also had evidence of a vessel strike.

d. Includes 1 animal with evidence of a vessel strike (healed series of propeller scars).

e. Includes 2 FIs, both of which were live entanglements in commercial blue crab trap/pot gear (both released alive, 1 seriously injured and 1 CBD if seriously injured).

~~Table 1. Common bottlenose dolphin strandings occurring in the Jacksonville Estuarine System, South Carolina, from 2009 to 2013, as well as number of strandings for which evidence of human interactions (HI) 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**~~
~~Jacksonville Estuarine System~~	~~Total Stranded~~	~~7~~	~~17[a]~~	~~7~~	~~13~~	~~27~~	~~71~~
	~~Human Interaction~~						
	~~---Yes~~	~~3[b]~~	~~1[c]~~	~~2[d]~~	~~6[e]~~	~~6[f]~~	~~18~~
	~~---No~~	~~0~~	~~4~~	~~1~~	~~0~~	~~2~~	~~7~~
	~~---CBD~~	~~4~~	~~12~~	~~4~~	~~7~~	~~19~~	~~46~~

~~[a] 14 of these strandings were part of the St. Johns River UME during May-September 2010.~~

~~[b] This total includes 1 entanglement interaction with crab trap/pot gear (mortality).~~

~~[c] This HI was an entanglement interaction with crab trap/pot gear (released alive, not seriously injured).~~

~~[d] These HIs include 1 mortality from an entanglement in commercial blue crab trap/pot gear and 1 animal observed entangled in and trailing unknown material/gear that was seriously injured.~~

~~[e] This total includes 3 entanglement interactions with commercial blue crab trap/pot gear (1 mortality, 1 animal released alive seriously injured, and 1 animal released alive not seriously injured). Also included is 1 entanglement interaction with hook and line gear and debris (serious injury).~~

~~[f] This total includes 1 entanglement interaction with commercial blue crab trap/pot gear (not seriously injured). In addition, another live animal was considered not seriously injured after being disentangled from an Aerobie (frisbee).~~

HABITAT ISSUES

This stock inhabits areas with significant drainage from industrial and urban sources, and as such is exposed to contaminants and nutrients in runoff from them. No contaminant analyses of dolphin tissues have yet been conducted in this area. In other estuarine areas where such analyses have been conducted, it has been suggested that exposure to anthropogenic contaminants could potentially result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Harmful algal blooms occur regularly in the St. Johns River (Brown *et al.* 2018). The most prevalent and persistent cyanotoxins from water samples collected in the St. Johns River, microcystins and noldularins, have been detected throughout the year. Dolphins utilizing this habitat may be exposed to these cyanotoxins. Brown *et al.* (2018) suggested that the high levels of human activity coupled with environmental stressors characterizing the St. Johns River could lead to the dolphins utilizing this area being more susceptible to the harmful effects of cyanotoxin exposure.

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 JES 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.~~ However, this stock is considered strategic under the MMPA because the documented mortalities and serious injuries are incomplete and biased low, and likely exceed PBR. While the abundance of the JES Stock is currently unknown, based on the previous abundance estimate (e.g., Caldwell (2001), it is likely small and therefore relatively few mortalities and serious injuries would exceed PBR. The documented minimum mean annual human-caused mortality for the JES stock for 2016–2020 was 2.0, with all mortalities having evidence of fishery interactions (crab trap/pot and hook and line gear). However, it is likely the estimate of annual fishery-caused mortality and serious injury is biased low as indicated above (see Annual Human-Caused Mortality and Serious Injury section). In addition, some of the fishery and other sources of human-caused mortalities and serious injuries were averted through mitigation efforts (i.e., disentanglement), and while these are not counted against the stock's PBR (NMFS 2012), when using the documented mean annual human-caused mortality and serious injury as a minimum proxy for the total, such cases are relevant to consider given that undocumented cases cannot be mitigated. Overall, 35% of the animals that stranded during 2016–2020 showed evidence of human interactions, with the majority of those confirmed as fishery interactions (24% of strandings showed evidence of fishery interactions). Wells *et al.* (2015) estimated that only one-third of bottlenose dolphin carcasses in estuarine environments are recovered, indicating significantly more mortalities may occur than are recovered. Therefore, the documented mortalities are incomplete and must be considered minimum counts of total human-caused and 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 optimum sustainable population is unknown. There are insufficient data to determine population trends for this stock.

~~However, there are commercial fisheries, including crab trap/pot fisheries, operating within this stock's boundaries and these fisheries have little to no observer coverage. The impact of crab trap/pot fisheries on estuarine bottlenose dolphins is currently unknown, but has been shown previously to be considerable in the similar Charleston Estuarine System Stock 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.~~

REFERENCES CITED

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.

Brown, A., A. Foss, M.A. Miller and Q. Gibson. 2018. Detection of cyanotoxins (microcystins/nodularins) in livers from estuarine and coastal bottlenose dolphins (*Tursiops truncatus*) from Northeast Florida. Harmful Algae 76:22–34.

~~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.~~

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112:1–23.

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

Caldwell, M. 2016a. Historical seasonal density and distribution patterns of *Tursiops truncatus* in northeast Florida. Aquat. Mamm. 42(1):74–88.

Caldwell, M. 2016b. Historical evidence of *Tursiops truncatus* exhibiting habitat preference and seasonal fidelity in northeast Florida. Aquat. Mamm. 42(1):89–103.

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn.

2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

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

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 Environ. 319: 147–172.

Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1): 107–117.

Maze-Foley, K. and L.P. Garrison. in prep. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2022-XX. XX pp.

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

~~Maze-Foley, K. and L.P. Garrison. in prep a. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2007-2011.~~

~~Maze-Foley, K. and L.P. Garrison. in prep b. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2012.~~

~~Maze-Foley, K. and L.P. Garrison. in prep c. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2013.~~

Mazzoil, M., Q. Gibson, W.N. Durden, R. Borkowski, G. Biedenbach, Z. McKenna, N. Gordon, K. Brightwell, M. Denny, E. Howells, and J. Jakush. 2020. Spatiotemporal movements of common bottlenose dolphins (*Tursiops truncatus truncatus*) in Northeast Florida, USA. Aquat. Mamm. 46:285–300.

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. Fla. Sci. 68(4): 217–226.

Morris, S.E., J.L. Zelner, D.A. Fauquier, T.K. Rowles, P.E. Rosel, F. Gulland and B.T. Grenfell. 2015. Partially observed epidemics in wildlife hosts: Modelling an outbreak of dolphin morbillivirus in the northwestern Atlantic, June 2013–2014. J. R. Soc. Interface 12:20150676.

NMFS 2012. Process for distinguishing serious from non-serious injury of marine mammals: Process for injury determinations. National Marine Fisheries Service Policy Directive PD 02-038-01. January 2012. Available from: http://www.nmfs.noaa.gov/pr/laws/mmpa/policies.htm [Federal Register Notice, Vol. 77, No. 14, page 3233, January 23, 2012]

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available at: http://www.nmfs.noaa.gov/op/pds/index.html

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18: 278–290.

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Molec. Ecol. 18: 5030–5045.

Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded common bottlenose dolphins in southeastern Louisiana after the Deepwater Horizon oil spill. Endang. Species Res. 33:221–234.

Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Env. Toxic. Chem. 21(12): 2752–2764.

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. Conserv. Genet. 6(5): 715–728.

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.

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1): 355–368.

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.

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.

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*) Indian River Lagoon 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 of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (e.g., Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; Rosel *et al.* 2009; Litz *et al.* 2012), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (e.g., Wells *et al.* 1987; Sellas *et al.* 2005; Balmer *et al.* 2008; Rosel *et al.* 2017~~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 reported for the west coast of Florida (Sellas *et al.* 2005).~~

Figure 1. ***Geographic extent of the Indian River Lagoon Estuarine System (IRLES) Stock. Dashed lines denote the boundaries.***

Multiple studies utilizing varying methods such as ~~freeze-branding,~~ photo-ID, ~~and~~ radio telemetry, and genetics support the designation of common bottlenose dolphins in the Indian River Lagoon (IRL) as a distinct stock with long-term site fidelity to the region (Odell and Asper 1990; Mazzoil *et al.* 2005; Mazzoil *et al.* 2008a; Mazzoil *et al.* 2008b; Richards *et al.* 2013; Titcomb *et al.* 2015). Odell and Asper (1990) reported that none of the 133 freeze-branded dolphins from the IRL were observed outside of the system during their ~~4~~four-year monitoring period from 1979 to 1982 and suggested that there may be an additional discrete group of dolphins in the southern end of the system. Mazzoil *et al.* (2005) identified some of these freeze-branded animals in their 1996–2001 photo-ID study, with some dolphins being seen in the IRL over twenty years. Several photo-ID studies have provided evidence for spatial separation and minimal degree of movement between dolphins in the IRL and those occurring in the nearshore coastal waters of the Atlantic Ocean between Sebastian and St. Lucie Inlets (Mazzoil *et al.* 2008a; Mazzoil *et al.* 2011). However, two studies identified movement of some dolphins between the IRL and adjacent estuarine and/or coastal waters (Durden *et al.* 2011; Hartel *et al.* 2020; Mazzoil *et al.* 2020). Finally, within the IRL estuarine system, photo-ID and genetic data suggest multiple communities are present (Mazzoil *et al.* 2008a; Titcomb *et al.* 2015; Mazzoil *et al.* 2020). There is still a need to better understand movement patterns between the IRL and adjacent estuarine waters.

Mazzoil *et al.* (2020) have suggested splitting the Mosquito Lagoon area out of the IRL estuarine system; further work to determine whether demographically independent populations inhabit these two areas will help determine whether this change should be made. ~~A stranded dolphin from the IRL that was rehabilitated, freeze-branded and released into the IRL was recaptured 14 years later in the IRL during a health assessment project (Mazzoil *et al.* 2008b). Photo-ID studies have provided evidence that some dolphins in the IRL exhibit both short-term and long-term site fidelity (Mazzoil *et al.* 2005; Mazzoil *et al.* 2008a). During a 5-year study (1996–2001) in the IRL, 67 individual dolphins were sighted 8 or more times, which included 11 dolphins freeze-branded from the Odell and Asper (1990) study that were sighted at least once (Mazzoil *et al.* 2005). In addition, Mazzoil *et al.* (2008a) suggested that at least 3 different dolphin communities exist within the IRL based on analyses of photo-ID data. Radio-tracking of 2two rehabilitated dolphins stranded in the IRL indicated that neither dolphin left the IRL from the time of release until their deaths in 100 days and 7 days, respectively (Mazzoil *et al.* 2008b). A photo-ID study conducted from 2006–2008 provided evidence for spatial separation and minimal degree of movement between dolphins in the IRL and those occurring in the nearshore coastal waters of the Atlantic Ocean between Sebastian and St. Lucie Inlets (Mazzoil *et al.* 2008a). However, results from aerial surveys to estimate abundance during 2002–2004 (Durden *et al.* 2011, described under "Population Size" below) seem to contradict an exclusively resident population, and rather suggest movements of IRL dolphins between adjacent estuarine and/or coastal waters. There is still a need to better understand movement patterns between the IRL and adjacent coastal and estuarine waters. The boundaries of this stock are subject to change upon further study.~~

The Indian River Lagoon Estuarine System (IRLES) Stock on the Atlantic coast of Florida extends from Ponce de Leon Inlet in the north to Jupiter Inlet in the south and encompasses all estuarine waters in between (Figure 1), including but not limited to the Intracoastal Waterway, Mosquito Lagoon, Indian River, Banana River and the St. Lucie Estuary. Five inlets and the Cape Canaveral Locks connect the IRLES to the Atlantic Ocean. This definition of the IRLES has been used by a number of researchers (e.g., Kent *et al.* 2008; Durden *et al.* 2021)~~ and is the most expansive definition~~. ~~Some researchers truncate the southern border at the St. Lucie Inlet.~~

Dolphins residing within estuaries north and south of this stock are currently not included in any Stock Assessment Report. It is unknown~~There are insufficient data to determine~~ whether animals in estuarine waters south of the IRLES exhibit affiliation to the Biscayne Bay Stock or are simply transient animals associated with coastal stocks. Similarly, it is not known~~there are insufficient data to determine~~ whether animals in estuarine waters north of the IRLES exhibit affiliation to the IRLES Stock or to the Jacksonville Estuarine System Stock to the north or are simply transients. There is ~~relatively~~ limited estuarine habitat along the coastline south of the IRLES but some potentially suitable habitat north of the IRLES. Further research is needed to establish affinities of dolphins in these regions. It should be noted that during 2016–2020~~2009–2013~~, there were 29~~32~~ stranded common bottlenose dolphins in the region north of the IRLES in estuarine~~enclosed~~ waters. There was evidence of human interaction for four of the strandings, including ~~3~~two interactions with hook and line fishing gear, one entanglement in commercial blue crab trap/pot gear, and one entanglement in unidentified rope/line. The two interactions with hook and line gear were both mortalities for which evidence suggested the hook and line gear contributed to cause of death.~~1 mortality, 1 serious injury, 1 live release without serious injury) and 2~~The entanglement in commercial blue crab trap/pot gear was a live release for which it could not be determined if the animal was seriously injured following mitigation efforts (initial determination was seriously injured; Maze-Foley and Garrison in prep). The entanglement in unidentified rope/line involved a live animal that shed the gear on its own and was considered not seriously injured (Maze-Foley and Garrison in prep). ~~entanglement in blue crab trap/pot gear (1 mortality and 1 live release without serious injury) (Maze-Foley and Garrison in prep a,b).~~ During 2016–2020~~2009–2013~~ there was one~~were 3~~ estuarine stranding south of the IRLES for which evidence indicated interaction with an unknown fishery (healed scars). In addition to animals included in the stranding database, in estuarine waters north of the IRLES there was one at-sea observation of a dolphin entangled in commercial blue crab trap/pot gear. The dolphin shed the gear on its own and was considered not seriously injured~~were 3 at-sea observations of dolphins entangled in hook and line gear, crab trap/pot gear and thick line. All 3 dolphins were considered not seriously injured~~ (Maze-Foley and Garrison in prep~~ a,b~~).

POPULATION SIZE

The best available abundance estimate for the IRLES Stock of common bottlenose dolphins is 1,032 (95% CI:969–1,098; CV=0.03; Table 1). This is the mean estimate from four seasonal vessel-based capture-recapture photo-ID surveys conducted from summer 2016 to spring 2017 (Durden *et al.* 2021).

Earlier abundance estimates (>8 years old)

~~Population size estimates for this stock are greater than 8 years old and therefore the current population size for~~

~~the stock is considered unknown (Wade and Angliss 1997). Abundance estimates ranging from 206 to 816 dolphins (Leatherwood 1979; Thompson 1981; Leatherwood 1982; Burn *et al.* 1987; Mullin *et al.* 1990) were made in the 1970's and 1980's in response to common bottlenose dolphin live-capture fisheries where 68 dolphins were permanently removed between 1973 and 1988 for display in marine parks and use by the military (Scott 1990). No dolphins have been removed from the IRLES since 1989. Abundances based on aerial and small boat-based strip- or line-transect surveys were estimated to establish capture quotas or to assess the impact of the removals (Scott 1990). Scott (1990) suggested that a large number of common bottlenose dolphins moved into the IRLES during the summer from the adjacent Atlantic Ocean. However, preliminary analyses of extensive photo-ID data collected throughout the IRLES and the adjacent Atlantic from 2002 to 2008 do not support this hypothesis and indicate very few common bottlenose dolphins move between the IRLES and the Atlantic Ocean (Mazzoil *et al.* 2011).~~ During photo-ID studies conducted in the IRLES for three~~3~~ years from 2002 to 2005, 615 common bottlenose dolphins with distinct dorsal fins were identified (Mazzoil *et al.* 2008a). This number of dolphins is comparable to ~~the larger~~ abundances previously estimated (506–~~-~~816 dolphins) ~~which were~~ based on small boat surveys (Mullin *et al.* 1990) and a mark-recapture study (Burn *et al.* 1987)~~ and were probably less negatively biased compared to the aerial surveys~~. Seasonal aerial surveys were conducted from summer 2002 through spring 2004 (Durden *et al.* 2011). Abundance estimates were lowest in summer and highest in winter, ranging from 362 (CV=0.29) for summer 2003 to 1,316 (CV=0.24) for winter 2002–~~-~~2003 with an overall mean abundance of 662 (CV=0.09). ~~These results also do not support Scott (1990) regarding dolphin movements into the IRLES during summer.~~ The pattern of larger winter estimates occurred in both years of the Durden *et al.* (2011) study and was pronounced in two areas, Mosquito Lagoon and southern Indian River. Further aerial surveys were conducted from fall 2005 to winter 2010–2011, and as in the prior aerial surveys, estimates varied seasonally and differences were most pronounced in the Mosquito Lagoon and southern Indian River (Durden *et al.* 2017). Estimates ranged from 483 (95% CI:345–672) in summer 2008 to 1,947 dolphins (95% CI:1,198–2,590) in winter 2009– 2010, with an overall mean abundance of 1,032 dolphins (95% CI:809–1,255) (Durden *et al.* 2017).

Recent surveys and abundance estimates

Durden *et al.* (2021) conducted four seasonal vessel-based capture-recapture photo-ID surveys between August 2016 and May 2017 to estimate abundance of common bottlenose dolphins of the IRLES Stock. A robust design was used, with four seasonal primary periods, each with three secondary sessions. Surveys extended from Ponce Inlet in the north to Jupiter Inlet in the south and encompassed all estuarine waters in between. Coastal waters were not surveyed. The survey design included both alternating saw-tooth transects and depth-contour lines (~743 km in total length). Data were analyzed using program MARK via the RMark package in R. Estimates ranged from 981 (95% CI:882–1,090; CV=0.05) in winter to 1,078 (95% CI:968–1,201; CV=0.05) in summer. These estimates were corrected for the proportion of unmarked individuals. As there was little evidence for temporary emigration or transience for the IRLES Stock as a whole and the four seasonal estimates were similar, the best estimate for the IRLES Stock was the mean of the four seasonal estimates, 1,032 (95% CI:969–1,098; CV=0.03; 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 IRLES Stock is 1,032 (CV=0.03). The resulting minimum population estimate is 1,004 (Table 1).~~Present data are insufficient to calculate a minimum population estimate for the IRLES Stock of common bottlenose dolphins.~~

Current Population Trend

There are insufficient data to determine the population trends for this stock because of significant methodological differences in the surveys over time.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the IRLES Stock of common bottlenose dolphins is 1,004~~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. PBR for the IRLES Stock of common bottlenose dolphins is 10~~unknown~~.

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

Nest	**CV Nest**	**Nmin**	**Fr**	**Rmax**	**PBR**
1,032	0.03	1,004	0.5	0.04	10

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the IRLES Stock during 2016–2020~~2009-2013~~ is unknown~~ because this stock is known to interact with unobserved fisheries (see below)~~. The mean annual fishery-related mortality and serious injury during 2016–2020 based on strandings and at-sea observations identified as fishery-related (crab trap/pot and hook and line gear) was 3.9. Additional mean annual mortality and serious injury during 2016–2020 due to other human-caused sources was 1.8 (e.g., vessel strikes; see Other Mortality below). The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 5.7 (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 the only data 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, 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), and 5) strandings with evidence of fishery-related interactions occurred in waters north and south of the IRLES Stock boundary that are not included within any stock, and some or all of those strandings could have been part of this stock (see Stock Definition and Geographic Range section).~~The mean annual fishery-related mortality and serious injury for strandings and at-sea observations identified as fishery-caused was 4.4. No additional mortality or serious injury was documented from other human-caused actions. The minimum total mean annual human-caused mortality and serious injury for this stock during 2009-2013 was 4.4.~~

Fishery Information

~~The commercial fisheries that interact, or that potentially could interact, with this stock are the Category II Atlantic blue crab trap/pot; and Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot fisheries; and the Category III Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fishery (Appendix III).~~There are three commercial fisheries that interact, or that potentially could interact, with this stock. These include two Category II fisheries (Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot and Atlantic blue crab trap/pot) and one Category III fishery (Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line)). 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.

~~Crab~~ Trap/Pot

During 2016–2020 there were five documented entanglement interactions of common bottlenose dolphins in the IRLES area with trap/pot fisheries. During 2016 there was one mortality and one live animal disentangled from commercial blue crab trap/pot gear and released alive. 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 in prep). During 2017 there was one mortality in commercial blue crab trap/pot gear (the animal was also entangled in hook and line gear). Also in 2017, there was one animal entangled in unidentified trap/pot gear, and this animal was considered not seriously injured following mitigation efforts (initial determination was seriously injured; Maze-Foley and Garrison in prep). During 2020 there was one live animal disentangled from commercial blue crab trap/pot gear, and it could not be determined whether the animal was seriously injured following mitigation efforts (the initial determination was seriously injured (Maze-Foley and Garrison in prep). All of these entanglement interactions were documented within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021). The two mortalities and two live entanglements that were CBD for serious injury (CBD cases were prorated based on previous assignable injury events;

NMFS 2012; Maze-Foley and Garrison in prep) are included in the annual human-caused mortality and serious injury total for this stock (Table 2).

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.

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

~~Between 2009 and 2013, 3 bottlenose dolphins were documented entangled in commercial blue crab trap/pot gear (i.e., rope and/or pots attached), and disentanglement efforts were made for each. All 3 were released alive without serious injuries (Maze-Foley and Garrison in prep a,b). The 3 cases were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11 June 2014). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab trap/pot gear.~~

Hook and Line

During 2016–2020, within the IRLES area, there were 24 documented interactions within the stranding data of common bottlenose dolphins entangled in or with ingested hook and line fishing gear (in 2016 [n=4], 2017 [n=9], 2018 [n=3], 2019 [n=4] and 2020 [n=4]). During 2016, there were three mortalities and one live animal considered not seriously injured following mitigation efforts (the initial determination was seriously injured (Maze-Foley and Garrison in prep)). For two of the mortalities, available evidence suggested the hook and line gear did not contribute to cause of death, and for the third mortality, evidence suggested the gear did contribute to cause of death (this animal was also entangled in a monofilament cast net). During 2017, there were six mortalities; for three of these mortalities, evidence suggested the hook and line gear contributed to cause of death (one of these animals was also entangled in commercial blue crab trap/pot gear; one mortality was described in Marks *et al.* 2020), and for the remaining three mortalities, evidence suggested the hook and line gear did not contribute to cause of death. Also in 2017, there were three live animals considered not seriously injured following mitigation efforts (the initial determinations were seriously injured (Maze-Foley and Garrison in prep). During 2018, there were three mortalities; for two of these mortalities, evidence suggested the hook and line gear contributed to cause of death, and for the remaining mortality, evidence suggested the hook and line gear did not contribute to cause of death. During 2019, there were also three mortalities; for two of these mortalities, evidence suggested the hook and line gear contributed to cause of death, and for the remaining mortality, evidence suggested the hook and line gear did not contribute to cause of death. Also in 2019, one live animal was considered seriously injured (Maze-Foley and Garrison in prep). During 2020, there were also three mortalities; for two of these mortalities, evidence suggested the hook and line gear contributed to cause of death, and for the remaining mortality, it could not be determined whether the hook and line gear contributed to cause of death. Also in 2020, there was one live animal for which it could not be determined whether the animal was seriously injured following mitigation efforts (the initial determination was seriously injured [Maze-Foley and Garrison in prep]). The 10 mortalities for which evidence suggested the hook and line gear contributed to cause of death, the one serious injury, and the one live animal for which it could not be determined (CBD) whether it was seriously injured (the CBD case was prorated based on previous assignable injury events; NMFS 2012; Maze-Foley and Garrison in prep) are included in the annual human-caused mortality and serious injury total for this stock (Table 2). All of these cases were included in the stranding database and in the stranding totals presented in Table 3 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021).

In addition to the interactions documented within the stranding data, seven live common bottlenose dolphins were observed at-sea (in 2016 [n=2], 2017 [n=1], 2019 [n=1] and 2020 [n=3]) entangled in hook and line fishing gear. Five dolphins were considered seriously injured and are included in the annual human-caused mortality and serious injury total for this stock (Table 2). The remaining two dolphins were considered not seriously injured (Maze-Foley and Garrison in prep).

It should be noted that, in general, it cannot be determined if rod and reel hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no observer program. The documented interactions in this gear represent a minimum known count of interactions in the last five years.

For additional information on historic interactions with hook and line gear for common bottlenose dolphins in the IRLES, see Stolen *et al.* (2012). ~~Stranding data from 1997 through 2009 were used to investigate hook and line gear interactions with common bottlenose dolphins in the IRLES (Stolen *et al.* 2012). During the 13-year study, 57 dolphins (16% of dolphins examined) were found with evidence of fishing gear (single or multi-strand line, fishing hooks, metal sinkers, swivels, and/or lures). Forty-five dolphins ingested gear, 10 dolphins had gear externally wrapped or embedded, and in 2 instances gear was present both externally and internally. In total, 18 interactions (32%) with gear were considered fatal (gear was cause of death) and 23 (40%) were considered incidental (gear did not cause significant tissue or functional damage). While ingested gear was more common than external gear interactions, in most cases it was considered not fatal. However, interactions involving ingested line wrapped around the base of the larynx were always fatal. Occurrence of gear entanglements was less frequent than ingestion of gear but was almost always considered severe and often fatal. Stolen *et al.* (2012) noted that the nature of this study resulted in a conservative estimate of the effects of hook and line fishing for several reasons, including: nonlethal effects of gear interactions could not be determined; carcasses with gear interactions may not always be found by stranding personnel; and animals decompose rapidly in Florida making entanglement difficult to document.~~

~~Between 2009 and 2013, there were 25 documented strandings with evidence of hook and line fishery interaction (see Other Mortality below). Nineteen of the 25 were mortalities, 1 was released alive with serious injuries, and 5 were released alive without serious injuries (Maze-Foley and Garrison in prep a,b,c). It should be noted that, in general, it cannot be determined if hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no systematic observer program.~~

Other Mortality

During 2016–2020 within the IRLES area, there were six documented interactions of common bottlenose dolphins in other gear types or from other human-caused sources. There were four documented mortalities: one mortality (2016) involving an entanglement in a monofilament cast net (this animal was also entangled in hook and line gear); a second mortality (2017) had a large metal rod in its forestomach and severe lacerations to its rostrum; a third mortality (2018) resulted from entanglement in a navigational buoy; and a fourth mortality (2018) resulted from an entanglement in unknown fishing gear (this animal was also entangled in hook and line gear). In addition, there were two live animals considered not seriously injured following mitigation efforts (the initial determinations were seriously injured [Maze-Foley and Garrison in prep]). One live animal was entangled in a Hawaiian sling/spear and the other was trapped within a construction boom. All of these cases were included in the stranding database and in the stranding totals presented in Table 3 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021). Two of the mortalities are included in the annual human-caused mortality and serious injury total for this stock as part of “other takes” (Table 2). The two mortalities also entangled in hook and line gear are already counted under that gear type.

Also during 2016–2020 within the IRLES area, there were four documented mortalities of common bottlenose dolphins with evidence of a vessel strike. In two cases, evidence suggested the vessel strike contributed to cause of death, and these two mortalities are included in the annual human-caused mortality and serious injury total for this stock (Table 2). All of these cases were included in the stranding database and in the stranding totals presented in Table 3 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021). An earlier study by Bechdel *et al.* (2009), using data from 1996 to 2006, examined impacts of motorized vessels on common bottlenose dolphins in the IRLES suggested that continual vessel avoidance, lack of rest, and projected increases in anthropogenic impacts may result in chronic stress for dolphins inhabiting the IRLES.

In addition to the interactions documented within the stranding data and those described in the Hook and Line section above, during 2016–2020, seven live common bottlenose dolphins were observed at-sea (2017 [n=4], 2018 [n=2], and 2019 [n=1]) entangled in unidentified gear or with evidence of a vessel strike. Three animals were considered seriously injured due to entanglement in unidentified gear, and two were considered seriously injured due to a vessel strike (Maze-Foley and Garrison in prep). These five serious injuries are included in the annual human-caused mortality and serious injury total for this stock (Table 2).

All mortalities and serious injuries from known sources for the IRLES Stock are summarized in Table 2.

*Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (***Tursiops truncatus***) of the Indian River Lagoon 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**
Commercial Blue Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	3.5*[a]
Unidentified Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	
Hook and Line	2016–2020	Stranding Data and At-Sea Observations	NA	16*[b]
Mean Annual Mortality due to commercial fisheries (2016–2020)			**3.9**	
Mean Annual Mortality due to other takes (2016–2020) (other fishing gear, unidentified gear, vessel strikes)			**1.8***	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)			**5.7**	

a. Includes two cases of CBD which were prorated based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison in prep). There was one non-calf entanglement in which the post-mitigation determination was CBD, and this CBD was prorated as 0.46 (rounded to 0.5) serious injuries. There was one calf entanglement in which the post-mitigation determination was CBD, and it was prorated as a serious injury (1 serious injury). Therefore, the total for these two CBD cases was 1.5 serious injuries.

b. Includes one calf entanglement in which the post-mitigation determinations was CBD. The CBD was prorated as not seriously injured (0 serious injuries) based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison in prep).

~~A common bottlenose dolphin live-capture fishery operating between 1973 and 1988 in the IRLES permanently removed 68 bottlenose dolphins for display in marine parks and for use by the military (Scott 1990). No dolphins have~~

~~been removed from the IRLES since 1989.~~

Strandings

During 2016–2020, 187 common bottlenose dolphins were reported stranded within the IRLES 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 48 of the strandings. No evidence of human interaction was detected for 23 strandings, and for the remaining 116 strandings, it could not be determined if there was evidence of human interaction. Human interactions were from numerous sources, including entanglements with commercial blue crab trap/pot gear, hook and line gear, unidentified fishing gear, as well as a cast net, and a sling/spear. There was also a boom entrapment, an entanglement in a navigational buoy, evidence of vessel strikes for several animals, and an animal found with a metal rod in its forestomach. 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.

~~A total of 227 common bottlenose dolphin strandings were documented within the IRLES from 2009 through 2013 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 11 June 2014). Evidence of human interactions (e.g., fishing gear or debris entanglement or ingestion, mutilation, boat collision) was detected for 36 strandings; no evidence of human interactions was found for 42 animals, and for the remaining 149 animals, it could not be determined if there was evidence of human interactions. Thirty of the 36 strandings for which evidence of human interactions was detected involved fisheries interactions, including the 3 crab trap/pot interactions discussed above. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008; Stolen *et al.* 2012). Twenty-five strandings showed evidence of interaction with hook and line fishing gear, including entanglement in or ingestion of monofilament line, hooks or lures. These interactions may or may not have been the cause of the animal's death, and in some cases the relationship between the gear and cause of death could not be determined.~~

~~Two identified dolphins from the IRLES were disentangled from fishing gear multiple times. One dolphin was disentangled and released alive on 3 separate occasions (Maze-Foley and Garrison in prep a), and subsequently stranded dead entangled in fishing gear. The second dolphin stranded dead as a result of tail fluke entanglement in fishing gear following 3 prior disentanglement and live release interventions.~~

~~In addition to animals included in the stranding database, in 2010 and 2012, there were at-sea observations in the IRLES area of a dolphin entangled in fishing gear (wrapped around body parts). Both dolphins were considered seriously injured (Maze-Foley and Garrison in prep a,b).~~

~~There are a number of difficulties associated with the interpretation of stranding data. It is possible that some of the stranded dolphins may have been from a nearby coastal stock, although the proportion of stranded dolphins belonging to another stock cannot be determined because it is often unclear from where the stranded carcasses originated. However, preliminary analyses of photo-ID data suggest that many of the stranded dolphins with distinct dorsal fins found within the IRLES had been photographed within the estuary previously, and furthermore, many of them were found within their known photo-ID home ranges (Mazzoil *et al.*, in preparation).~~ 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; 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.

For more information on historic stranding data (1977–2005) from the IRLES, see Stolen *et al.* (2007), who examined ~~Bottlenose dolphin stranding data from 1977 to 2005 were analyzed by Stolen *et al.* (2007) to examine~~ spatio-temporal aspects of strandings, age/sex specific mortality patterns and human-related mortality in the IRLES. ~~Stolen *et al.* (2007) reported that 834 total dolphins stranded during the time frame of the study, which ranged from a low of 11 animals in 1985 to a high of 61 animals in 2001. Significant findings were: more strandings occurred in spring and summer; more of the strandings were males; and juveniles stranded more frequently, followed by adults, then calves (Stolen *et al.* 2007). Human interaction (HI) (e.g., gear and debris entanglement or ingestion, mutilation, boat collision) was reported in 10.2% (n=85) of strandings. Significantly more males showed evidence of HI than~~

~~females. Most strandings with HI evidence were reported in spring and summer and found in Brevard County (n=64). Ingestion of or entanglement in recreational fishing gear accounted for 54.1% (n=46), and commercial fishing interaction accounted for 23.5% (n=20) of strandings where HI was recorded (Stolen *et al.* 2007).~~

The IRLES Stock has been experiencing~~ed~~ ~~several~~ Unusual Mortality Events (UMEs) since at least 1982 (Lipscomb *et al.* 1994; Duignan *et al.* 1996; Bossart *et al.* 2010; Brightwell *et al.* 2020; https://www.fisheries.noaa.gov/national/marine-life-distress/active-and-closed-unusual-mortality-events). ~~In 2001, there was a record high number of strandings in the IRLES (n=61) (Stolen *et al.* 2007). A UME was declared when 34 of these dolphins stranded in a relatively short time period (7 May – 25 August 2001) and were confined to a relatively small geographic area in central Brevard County (Stolen *et al.* 2007). The cause of this UME was undetermined; however, saxitoxin, a biotoxin produced by the algae *Pyrodinium bahamense*, was suspected to be a factor.~~ During the past 15 years, ~~T~~the IRLES has experienced three UMEs. ~~another UME in 2008.~~ From May to August of 2008, a total of 47 common bottlenose dolphins were recovered from the northern IRLES. One dolphin from the Central Florida Coastal Stock was also considered part of this UME (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 13 September 2012). Infectious disease is suspected as a possible cause of this event. During January to December 2013, another UME occurred within the IRLES. Elevated strandings occurred in the northern and central IRLES in Brevard County. The cause of this UME was undetermined~~investigation and analyses are ongoing~~. 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). However, several confirmed morbillivirus positive animals were recovered from within the IRLES Stock area.~~Finally, 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, 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, several confirmed morbillivirus positive animals have been recovered from within the IRLES Stock area. The UME is still ongoing and work continues to determine the effect of this event on all bottlenose dolphin stocks in the Atlantic.~~

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

~~Impacts of motorized vessels on bottlenose dolphins in the IRLES were investigated using photo-ID data collected from September 1996 to October 2006 (Bechdel et al. 2009). Six percent of distinctly marked individuals had injuries associated with vessel impact. Two counties, Martin and St. Lucie Counties, had the highest rate (9.9%) of boat-injured dolphins as well as the largest number of registered boaters per km² (237 boats/km²). During sightings with less than 5 vessels within 100 m of the dolphin group, changes in the frequency of feeding decreased and traveling increased. Resting behavior was the least observed activity (< 1% of observations) during the 10-year study. Bechdel et al. (2009) suggest that continual vessel avoidance, lack of rest, and projected increases in anthropogenic impacts may result in chronic stress for dolphins inhabiting the IRLES.~~

Table 3. Common bottlenose dolphin strandings occurring in the Indian River Lagoon 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.

COUNTY		**2016**	**2017**	**2018**	**2019**	**2020**	**TOTAL**
Volusia	Total Stranded	8	7	9	7	5	36

	HI--Yes	3	3	7	1	3	17
	HI--No	3	0	1	0	0	4
	HI--CBD	2	4	1	6	2	15
Seminole	Total Stranded	0	0	0	0	0	0
Brevard	Total Stranded	36	22	24	23	33	138
	HI--Yes	4	7	4	7	2	24
	HI--No	5	3	4	0	4	16
	HI--CBD	27	12	16	16	27	98
Indian River	Total Stranded	1	0	2	0	1	4
	HI--Yes	0	0	2	0	0	2
	HI--No	1	0	0	0	0	1
	HI--CBD	0	0	0	0	1	1
St. Lucie	Total Stranded	0	3	0	1	1	5
	HI--Yes	0	2	0	0	0	2
	HI--No	0	1	0	0	0	1
	HI--CBD	0	0	0	1	1	2
Martin	Total Stranded	1	2	0	0	1	4
	HI--Yes	1	1	0	0	1	3
	HI--No	0	1	0	0	0	1
	HI--CBD	0	0	0	0	0	0
TOTAL	Total Stranded	46	34	35	31	41	187
	HI--Yes	8	13	13	8	6	48
	HI--No	9	5	5	0	4	23
	HI--CBD	29	16	17	23	31	116

~~Table 2. Bottlenose dolphin strandings by county within the Indian River Lagoon System from 2009 to 2013, 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 11 June 2014). Please note human interaction does not necessarily mean the interaction caused the animal's death.~~

~~COUNTY~~		~~2009~~	~~2010~~	~~2011~~	~~2012~~	~~2013~~	~~TOTAL~~
~~**Volusia**~~	~~**Total Stranded**~~	~~**2**~~	~~**1**~~	~~**6**~~	~~**5**~~	~~**8**~~	~~**22**~~
	~~Human Interaction~~						
	~~---Yes~~	~~1~~	~~1~~	~~2~~	~~1~~	~~1~~	~~6~~
	~~---No~~	~~0~~	~~0~~	~~1~~	~~0~~	~~1~~	~~2~~
	~~---CBD~~	~~1~~	~~0~~	~~3~~	~~4~~	~~6~~	~~14~~
~~**Seminole**~~	~~**Total Stranded**~~	~~**1**~~	~~**0**~~	~~**0**~~	~~**0**~~	~~**0**~~	~~**1**~~
	~~Human Interaction~~						
	~~---Yes~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~
	~~---No~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
	~~---CBD~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~**Brevard**~~	~~**Total Stranded**~~	~~**25**~~	~~**32**~~	~~**18**~~	~~**38**~~	~~**70**~~	~~**183**~~
	~~Human Interaction~~						
	~~---Yes~~	~~3~~	~~5~~	~~1~~	~~8~~	~~7~~	~~24~~
	~~---No~~	~~4~~	~~6~~	~~3~~	~~9~~	~~13~~	~~35~~
	~~---CBD~~	~~18~~	~~21~~	~~14~~	~~21~~	~~50~~	~~124~~
~~**Indian River**~~	~~**Total Stranded**~~	~~**1**~~	~~**2**~~	~~**1**~~	~~**3**~~	~~**4**~~	~~**11**~~
	~~Human Interaction~~						
	~~---Yes~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~1~~
	~~---No~~	~~0~~	~~0~~	~~0~~	~~0~~	~~2~~	~~2~~
	~~---CBD~~	~~1~~	~~2~~	~~1~~	~~2~~	~~2~~	~~8~~
~~**St. Lucie**~~	~~**Total Stranded**~~	~~**1**~~	~~**0**~~	~~**5**~~	~~**0**~~	~~**0**~~	~~**6**~~
	~~Human Interaction~~						
	~~---Yes~~	~~0~~	~~0~~	~~4~~	~~0~~	~~0~~	~~4~~
	~~---No~~	~~1~~	~~0~~	~~1~~	~~0~~	~~0~~	~~2~~
	~~---CBD~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~**Martin**~~	~~**Total Stranded**~~	~~**1**~~	~~**1**~~	~~**2**~~	~~**0**~~	~~**0**~~	~~**4**~~

	~~Human Interaction~~						
	~~—Yes~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
	~~—No~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1~~
	~~—CBD~~	~~1~~	~~1~~	~~1~~	~~0~~	~~0~~	~~3~~
~~TOTAL~~	~~Total Stranded~~	**~~31~~**	**~~36~~**	**~~32~~**	**~~46~~**	**~~82~~**	**~~227~~**
	~~Human Interaction~~						
	~~—Yes~~	~~5~~	~~6~~	~~7~~	~~10~~	~~8~~	~~36~~
	~~—No~~	~~5~~	~~6~~	~~6~~	~~9~~	~~16~~	~~42~~
	~~—CBD~~	~~21~~	~~24~~	~~19~~	~~27~~	~~58~~	~~149~~

HABITAT ISSUES

The IRLES is a shallow water estuary with little tidal influx, which limits water exchange with the Atlantic Ocean. This allows for accumulation of land-based effluents and contaminants in the estuary, as well as fresh-water dilution from run-off and rivers. A large portion of Florida's agriculture also drains into the IRLES~~, including all of the sugarcane, approximately 38% of citrus and 42% of other vegetable crops~~ (Miles and Pleuffer 1997). Dolphins in the IRLES were found to have concentrations of contaminants at levels of possible toxicological concern. Hansen *et al.* (2004) suggested that polychlorinated biphenyl (PCBs) concentrations in blubber samples collected from remote biopsy of IRLES dolphins were sufficiently high to warrant additional sampling. Fair *et al.* (2010) found potentially harmful levels of several different chemical contaminants, including some that may act as endocrine disruptors. Mercury levels have also been found to be high in dolphins from the IRLES, with some levels associated with toxic effects in marine mammals (Durden *et al.* 2007; Stavros *et al.* 2007; 2008; 2011). In addition, concentrations appear to be higher in the northern portion of the IRLES compared to the southern portions (Schaefer *et al.* 2015; Titcomb *et al.* 2017). Concentrations of total mercury in IRLES dolphins were associated with lower levels of total thyroxine, triiodothyronine, lymphocytes, eosinophils and platelets and increases in blood urea nitrogen and gamma-glutamyl transferase (Schaefer *et al.* 2011). However, there have been no reports of mortalities in the IRLES resulting solely from contaminant concentrations.

~~Durden *et al.* (2007) found mean mercury concentrations in IRLES dolphins were positively correlated with age and length and tended to be slightly higher than dolphins from the Gulf of Mexico and South Carolina coasts. In the same study, 5 animals were found to have mercury concentrations exceeding 100 ppm, which may be associated with toxic effects in marine mammals (Durden *et al.* 2007). Stavros *et al.* (2007, 2008) reported that blood and skin samples obtained from IRLES dolphins had concentrations of total mercury among the highest reported in free-living marine mammals worldwide and approximately 4 to 5 times the concentrations found in dolphins from Charleston, South Carolina. Concentrations of total mercury in IRLES dolphins were associated with lower levels of total thyroxine, triiodothyronine, lymphocytes, eosinophils and platelets and increases in blood urea nitrogen and gamma-glutamyl transferase (Schaefer *et al.* 2011). A further study of IRLES dolphins indicated that 33% of the stranded and 15% of the free-ranging dolphins from Florida exceeded the minimum 100 lg g_1 wet weight (ww) Hg threshold for hepatic damage previously published for marine mammals (Stavros *et al.* 2011).~~ In addition to contaminants, other aspects of water quality of the IRLES are a serious concern. Nonpoint source sewage pollution from septic tanks is a major contributor of eutrophication, or nutrient over-enrichment, to the system (Barile 2018; Lapointe *et al.* 2020; Greller *et al.* 2021), and has led to persistent harmful algal blooms (HABs) within the IRLES (Lapointe *et al.* 2020; Laureano-Rosario *et al.* 2021). During 2011–2017 following unprecedented HABs, the IRLES experienced a widespread loss of ~95% of seagrass (Lapointe *et al.* 2020; Greller *et al.* 2021). Severe weather events, such as hurricanes, tropical storms, and El Niño periods, can also increase nutrient loads and contribute to HABs, and there is concern that with future changes in climate, such as an increase in intensity and occurence of hurricanes and El Niño periods, the threats for HABs will increase within the IRLES (Phlips *et al.* 2020). Common bottlenose dolphins inhabiting the IRLES are at risk from exposure to and accumulation of neurotoxins produced by HAB species. Fire *et al.* (2020) examined liver tissue samples over 10 years and demonstrated that exposure to brevetoxin and saxitoxin occurred within dolphins in the IRLES even in the absence of detectable blooms. Health impacts of the toxin exposure are unknown (Fire *et al.*

2020). It should be noted that starting in December 2020, a high number of manatee mortalities have occurred in the IRLES as part of an ongoing manatee UME along the Atlantic Coast of Florida. The UME has been attributed to starvation due to the loss of seagrass within the IRLES as a result of poor water quality (https://myfwc.com/research/manatee/rescue-mortality-response/ume/). Whether the loss of seagrass beds may impact dolphin prey species such as pinfish that are dependent on those beds is unknown.

Recent studies of IRLES dolphins have shown evidence of infection with the cetacean morbillivirus. Positive morbillivirus titers were found in 12 of 122 (9.8%) live IRLES dolphins sampled between 2003 and 2007 (Bossart *et al.* 2010). In addition, approximately 6 to 10% of common bottlenose dolphins had lacaziosis (lobomycosis), a chronic mycotic disease of the skin caused by *Lacazia loboi* (Reif *et al.* 2006; Murdoch *et al.* 2008). ~~The prevalence of lacaziosis was also studied through examination of photo-ID data between 1996 and 2006 and was estimated to be 6.8% (Murdoch *et al.* 2008).~~ There are no published reports of mortalities resulting solely from this disease. Finally, Bossart *et al.* (2015) examined mucocutaneous lesions in free ranging common bottlenose dolphins within the IRLES area and found the presence of orogenital sessile papillomas, cutaneous lobomycosis, tattoo skin disease, nonspecific chronic to chronic-active dermatitis, and epidermal hyperplasia. The study suggested the high prevalence of lesions may reflect chronic exposure to anthropogenic and environmental stressors, such as contaminants and infectious or inflammatory disease.

Feeding or provisioning of wild common bottlenose dolphins has been documented in Florida, including areas of the Indian River Lagoon (Marks *et al.* 2020). Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter the natural behavior and increase the risk of injury or death to wild dolphins. There are links between provisioning wild dolphins, dolphin depredation of recreational fishing gear, begging behavior, and associated entanglement and ingestion of gear (Powell and Wells 2011; Christiansen *et al.* 2016; Hazelkorn *et al.* 2016; Powell *et al.* 2018).

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 IRLES 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 Marine Mammal Protection Act. The documented mean annual human-caused mortality for this stock for 2009 – 2013 was 4.4. However, there are several commercial fisheries operating within this stock's boundaries and these fisheries have little to no observer coverage. In particular, the impact of crab trap/pot fisheries on estuarine bottlenose dolphins is currently unknown, but has been shown previously to be considerable in the similar Charleston Estuarine System Stock area (Burdett and McFee 2004). 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. Documented human-caused mortalities from hook and line gear and crab pot gear entanglements as well as repeated UMEs reinforce concern for this stock. The removal of dolphins in live-capture fisheries in the 1970's and 1980's is also cause for concern; however, the effects of the permanent removals and the mortality events on stock abundance have not yet been completely determined. Stolen and Barlow (2003) concluded that the population's growth rate was stable or increasing from a model life table that was based on stranding data collected from 1978 to 1997 and incorporated the live capture removals.~~ However, this stock is considered strategic under the MMPA because the documented mortalities and serious injuries are incomplete and biased low, and likely exceed PBR. The documented minimum mean annual human-caused mortality for the IRLES stock for 2016–2020 was 5.7, with an annual average of 3.9 carcasses showing evidence of fishery interaction (crab trap/pot and hook and line gear) and 1.8 from other sources (e.g., vessel strikes, unknown fishing gear). This represents a minimum of nearly 60% of the IRLES Stock's PBR. However, it is likely the estimate of annual fishery-caused mortality and serious injury is biased low as indicated above (see Annual Human-Caused Mortality and Serious Injury section). In addition, some of the fishery and other sources of human-caused mortalities and serious injuries were averted through mitigation efforts (i.e., disentanglement), and while these are not counted against the stock's PBR (NMFS 2012), when using the documented mean annual human-caused mortality and serious injury as a minimum proxy for the total, such cases are relevant to consider given that undocumented cases cannot be mitigated. Overall, 26% of the animals that stranded during 2016–2020 showed evidence of human interactions, with the majority of those confirmed as fishery interactions (17% showed evidence of fishery interactions). Wells *et al.* (2015) estimated that only one-third of common bottlenose dolphin carcasses in estuarine environments are recovered, indicating significantly more mortalities may occur than are recovered. Therefore, the documented mortalities are incomplete and must be considered minimum counts of total human-caused and fishery-related mortality. Total U.S. 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 a 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.

REFERENCES CITED

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.

Barile, P.J. 2018. Widespread sewage pollution of the Indian River Lagoon system, Florida (USA) resolved by spatial analyses of macroalgal biogeochemistry. Mar. Pollut. Bull. 128:557–574.

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.

Bechdel, S.E., M.S. Mazzoil, M.E. Murdoch, E.M. Howells, J.S. Reif, S.D. McCulloch, A.M. Schaefer and G.D. Bossart. 2009. Prevalence and impacts of motorized vessels on bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. Aquat. Mamm. 35(3):367–377.

Bossart, G.D., J.S. Reif, A.M. Schaefer, J. Goldstein, P.A. Fair and J.T. Saliki. 2010. Morbillivirus infection in free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) from the southeastern United States: Seroepidemiologic and pathologic evidence of subclinical infection. Vet. Microbiol. 143:160–166.

Bossart, G.D., A.M. Schaefer, S. McCulloch, J. Goldstein, P.A. Fair and J.S. Reif. 2015. Mucocutaneous lesions in free-ranging Atlantic bottlenose dolphins *Tursiops truncatus* from the southeastern USA. Dis. Aquat. Org. 115:175–184.

Brightwell, K., E.M. Titcomb, M. Mazzoil and Q. Gibson. 2020. Common bottlenose dolphin (*Tursiops truncatus*) social structure and distribution changes following the 2008 Unusual Mortality Event in the Indian River Lagoon, Florida. Mar. Mamm. Sci. 36:1271–1290.

~~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.~~

Burn, D.M., D.K. Odell and E.D. Asper. 1987. A mark-resighting population estimate of the bottlenose dolphin, *Tursiops truncatus*, in the Indian-Banana river complex, Florida. Unpublished manuscript.

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112:1–23.

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

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

Christiansen, F., K.A. McHugh, L. Bejder, E.M. Siegal, D. Lusseau, E.B. McCabe, G. Lovewell, R.S. Wells. 2016. Food provisioning increases the risk of injury in a long-lived marine top predator. R. Soc. open sci. 3: 160560.

Duignan, P.J., C. House, D.K. Odell, R.S. Wells, L.J. Hansen, M.T. Walsh, D.J. St. Aubin, B.K. Rima, J.R. Geraci. 1996. Morbillivirus infection in bottlenose dolphins: Evidence for recurrent epizootics in the western Atlantic and Gulf of Mexico. Mar. Mamm. Sci. 12(4):499–515.

Durden, W.N., M.K. Stolen, D.H. Adams and E.D. Stolen. 2007. Mercury and selenium concentrations in stranded bottlenose dolphins from the Indian River Lagoon system, Florida. B. Mar. Sci. 81(1):37–54.

Durden, W.N., E.D. Stolen and M.K. Stolen. 2011. Abundance, distribution, and group composition of Indian River Lagoon bottlenose dolphins (*Tursiops truncatus*). Aquat. Mamm. 37(2):175–186.

Durden, W.N., E.D. Stolen, T.A. Jablonski, S.A. Puckett and M.K. Stolen. 2017. Monitoring seasonal abundance of Indian River Lagoon bottlenose dolphins (*Tursiops truncatus*) using aerial surveys. Aquat. Mamm. 43(1):90–112.

Durden, W.N., E.D. Stolen, T. Jablonski, L. Moreland, E. Howells, A. Sleeman, M. Denny, G. Biedenbach and M. Mazzoil. 2021. Abundance and demography of common bottlenose dolphins (*Tursiops truncatus truncatus*) in the Indian River Lagoon, Florida: A robust design capture-recapture analysis. PLoS ONE 16(4):e0250657.

Fair, P.A., J. Adams, G. Mitchum, T.C. Hulsey, J.S. Reif, M. Houde, D. Muir, E. Wirth, D. Wetzel, E. Zolman, W. McFee and G.D. Bossart. 2010. Contaminant blubber burdens in Atlantic bottlenose dolphins (*Tursiops truncatus*) from two southeastern US estuarine areas: Concentrations and patterns of PCBs, pesticides, PBDEs, PFCs, and PAHs. Sci. Total Environ. 408:1577–1597.

Fire, S.E., J.A. Browning, W.N. Durden and M.K. Stolen. 2020. Comparison of during-bloom and inter-bloom brevetoxin and saxitoxin concentrations in Indian River Lagoon bottlenose dolphins, 2002–2011. Aquat. Toxicol. 218:105371.

Gorzelany, J.F. 1998. Unusual deaths of two free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) related to ingestion of recreational fishing gear. Mar. Mamm. Sci. 14(3):614–617.

Greller, R., M. Mazzoil, E. Titcomb, B. Nelson, R. Paperno and S.H. Markwith. 2021. Environmental drivers of habitat use by common bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida, USA. Mar. Mamm. Sci. 37:512–532.

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

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 Environ. 319:147–172.

Hartel, E.F., W. Noke Durden, G. O'Corry-Crowe. 2020. Testing satellite telemetry within narrow ecosystems: nocturnal movements and habitat use of bottlenose dolphins within a convoluted estuarine system. Anim. Biotelemetry 8:13.

Hazelkorn, R.A., B.A. Schulte and T.M. Cox. 2016. Persistent effects of begging on common bottlenose dolphin (*Tursiops truncatus*) behavior in an estuarine population. Aquat. Mamm. 42(4):531–541.

Kent, E.E., M. Mazzoil, S.D. McCulloch and R.H. Defran. 2008. Group characteristics and social affiliation patterns of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. Fla. Sci. 71:149–168.

Lapointe, B.E., L.W. Herren, R.A. Brewton and P.K. Alderman. 2020. Nutrient over-enrichment and light limitation of seagrass communities in the Indian River Lagoon, an urbanized subtropical estuary. Sci. Total Environ. 699:134068.

Laureano-Rosario, A.E., M. McFarland, D.J. Bradshaww II, J. Metz, R.A. Brewton, T. Pitts, C. Perricone, S. Schreiber, N. Stockley, G. Wang, E.A. Guzmán, B.E. Lapointe, A.E. Wright, C.A. Jacoby and M.S. Twardowski. 2021. Dynamics of microcystins and saxitoxin in the Indian River Lagoon, Florida. Harmful Algae 103:102012.

Leatherwood, S. 1979. Aerial survey of the bottlenosed dolphin, *Tursiops truncatus*, and the west Indian manatee, *Trichechus manatus*, in the Indian and Banana rivers, Florida. Fish. Bull. 77:47–59.

Leatherwood, S. 1982. Size of bottlenose dolphin population(s) in Indian River, Florida. Rep. Int. Whal. Comm. 32: 567–568.

Lipscomb, T.P., S. Kennedy, D. Moffet and B.K. Ford. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. J. Wildl. Dis. 30(4):572–576.

Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1):107–117.

Marks, W., S. Burton, E. Stratton, E. Zolman, G. Biedenbach and A. Page-Karjian. 2020. A case study of monofilament line entanglement in a common bottlenose dolphin (*Tursiops truncatus*): entanglement, disentanglement, and subsequent death. BMC Vet. Res. 16:223.

Maze-Foley, K. and L.P. Garrison. in prep. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2022-XX. XX pp.

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

~~Maze-Foley, K. and L.P. Garrison. in prep a. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2007-2011.~~

~~Maze-Foley, K. and L.P. Garrison. in prep b. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2012.~~

~~Maze-Foley, K. and L.P. Garrison. in prep c. Preliminary serious injury determinations for small cetaceans off the southeast U.S. coast, 2013.~~

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. Fla. Sci. 68(4):217–226.

Mazzoil, M., J.S. Reif, M. Youngbluth, M.E. Murdoch, S.E. Bechdel, E. Howells, S.D. McCulloch, L.J. Hansen and G.D. Bossart. 2008a. Home ranges of bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida: Environmental correlates and implications for management strategies. EcoHealth 5(3):278–288.

Mazzoil, M.S., S.D. McCulloch, M.J. Youngbluth, D.S. Kilpatrick, M.E. Murdoch, B. Mase-Guthrie, D.K. Odell and G.D. Bossart. 2008b. Radio-tracking and survivorship of two rehabilitated bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon, Florida. Aquat. Mamm. 34:54–64.

Mazzoil, M., M.E. Murdoch, E. Howells, S. Bechdel, M. deSieyes, J.S. Reif, G.D. Bossart and S.D. McCulloch. 2011. Site fidelity and movement of bottlenose dolphins (*Tursiops truncatus*) on Florida's east coast: Atlantic Ocean and Indian River Lagoon estuary.~~Occurrence, site fidelity, and group size of bottlenose dolphins (*Tursiops truncatus*) along the Atlantic Ocean in Florida, and evaluation of movements into the Indian River Lagoon, Florida.~~ Fla. Sci. 74: 25–37.

Mazzoil, M., Q. Gibson, W.N. Durden, R. Borkowski, G. Biedenbach, Z. McKenna, N. Gordon, K. Brightwell, M. Denny, E. Howells and J. Jakush. 2020. Spatiotemporal movements of common bottlenose dolphins (*Tursiops truncatus truncatus*) in Northeast Florida, USA. Aquat. Mamm. 46:285–300.

Miles, C. and R. Pleuffer. 1997. Pesticides in canals of south Florida. Arch. Environ. Contam. Toxicol. 32:337–345.

Morris, S.E., J.L. Zelner, D.A. Fauquier, T.K. Rowles, P.E. Rosel, F. Gulland and B.T. Grenfell. 2015. Partially observed epidemics in wildlife hosts: Modelling an outbreak of dolphin morbillivirus in the northwestern Atlantic, June 2013–2014. J. R. Soc. Interface 12:20150676.

Mullin, K.D., R.R. Lohoefener, W. Hoggard, C.L. Roden and C.M. Rogers. 1990. Abundance of bottlenose dolphins, *Tursiops truncatus*, in the coastal Gulf of Mexico. Northeast Gulf Sci. 11(2):113–122.

Murdoch, E, J.S. Reif, M. Mazzoil, S.D. McCulloch, P.A. Fair and G.D. Bossart. 2008. Lobomycosis in bottlenose dolphins (*Tursiops truncatus*) from the Indian River Lagoon, Florida: Estimation of prevalence, temporal trends and spatial distribution. EcoHealth 5:289–297.

NMFS 2012. Process for distinguishing serious from non-serious injury of marine mammals: Process for injury determinations. National Marine Fisheries Service Policy Directive PD 02-038-01. January 2012. Available from: http://www.nmfs.noaa.gov/pr/laws/mmpa/policies.htm [Federal Register Notice, Vol. 77, No. 14, page 3233, January 23, 2012]

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available at: http://www.nmfs.noaa.gov/op/pds/index.html

Noke, W.D. and D.K. Odell. 2002. Interactions between the Indian River Lagoon blue crab fishery and the bottlenose dolphin, *Tursiops truncatus*. Mar. Mamm. Sci. 18:819–832.

Odell, D.K. and E.D. Asper. 1990. Distribution and movements of freeze-branded bottlenose dolphins in the Indian and Banana Rivers, Florida. Pages 515-540 *in*: S. Leatherwood and R. Reeves, (eds.) The bottlenose dolphin. Academic Press, San Diego, CA.

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18:278–290.

Phlips, E.J., S. Badylak, N.G. Nelson and K.E. Havens. 2020. Hurricanes, El Niño and harmful algal blooms in two sub-tropical Florida estuaries: Direct and indirect impacts. 10:1910.

Powell, J.R. and R.S. Wells. 2011. Recreational fishing depredation and associated behaviors involving common bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Mar. Mamm. Sci. 27(1):111–129.

Powell, J.R., A.F. Machernis, L.K. Engleby, N.A. Farmer and T.R. Spradlin. 2018. Sixteen years later: An updated evaluation of the impacts of chronic human interactions with bottlenose dolphins (*Tursiops truncatus*) in Panama City, Florida, USA. J. Cetacean Res. Manage. 19:79–93.

Reif, J.S., M.S. Mazzoil, S.D. McCulloch, R.A. Varela, J.D. Goldstein, P.A. Fair and G.D. Bossart. 2006. Lobomycosis in Atlantic bottlenose dolphins from the Indian River Lagoon, Florida. J. Amer. Vet. Med. Assoc. 228(1):104–108.

Richards, V.P., T.W. Greig, P.A. Fair, S.D. McCulloch, C. Politz, A. Natoli, C.A. Driscoll, A.R. Hoelzel, V. David, G.D. Bossart and J.V. Lopez. 2013. Patterns of population structure for inshore bottlenose dolphins along the eastern United States. J. Hered. 104(6):765–778.

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Mol. Ecol. 18:5030–5045.

Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded common bottlenose dolphins in southeastern Louisiana after the Deepwater Horizon oil spill. Endang. Species Res. 33:221–234.

Schaefer, A.M., H.W. Stavros, G.D. Bossart, P.A. Fair, J.D. Goldstein and J.S. Reif. 2011. Associations between mercury and hepatic, renal, endocrine and hematologic parameters in Atlantic bottlenose dolphins (*Tursiops truncatus*) along the eastern coast of Florida and South Carolina. Arch. Environ. Con. Tox. 61(4): 688–695.

Schaefer, A.M., E. Murdoch Titcomb, P.A. Fair, H.W. Stavros, M. Mazzoil, G.D. Bossart and J.S. Reif. 2015. Mercury concentrations in Atlantic bottlenose dolphins (*Tursiops truncatus*) inhabiting the Indian River Lagoon, Florida: Patterns of spatial and temporal distribution. Mar. Pollut. Bull. 97:544–547.

Scott, G.P. 1990. Management-oriented research on bottlenose dolphins by the Southeast Fisheries Center. Pages 623–639 *in*: S. Leatherwood and R. Reeves, (eds.) The bottlenose dolphin. Academic Press, San Diego, CA.

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. Conserv. Genet. 6(5): 715–728.

Stavros, H.W., G.D. Bossart, T.C. Hulsey and P.A. Fair. 2007. Trace element concentrations in skin of free-ranging bottlenose dolphins (*Tursiops truncatus*) from the southeast Atlantic coast. Sci. Total. Environ. 388: 300–315.

Stavros, H.W., G.D. Bossart, T.C. Hulsey and P.A. Fair. 2008. Trace element concentrations in blood of free-ranging bottlenose dolphins (*Tursiops truncatus*): Influence of age, sex and location. Mar. Pollut. Bull. 56: 348-379.

Stavros, H.S., M. Stolen, W. Noke Durden, W. McFee, G.D. Bossart and P.A. Fair. 2011. Correlation and toxicological inference of trace elements in tissues from stranded and free-ranging bottlenose dolphins (*Tursiops truncatus*). Chemosphere 82: 1649–1661.

~~Stolen, M.K. and J. Barlow. 2003. A model life table for bottlenose dolphins (*Tursiops truncatus*) from the Indian River Lagoon System, Florida, U.S.A. Mar. Mamm. Sci. 19(4): 630–649.~~

Stolen, M.K., W.N. Durden and D.K. Odell. 2007. Historical synthesis of bottlenose dolphin (*Tursiops truncatus*) stranding data in the Indian River Lagoon system, Florida, from 1977-2005. Fla. Sci. 70: 45–54.

Stolen, M., W. Noke Durden, T. Mazza, N. Barros and J. St. Leger. 2012. Effects of fishing gear on bottlenose dolphins (*Tursiops truncatus*) in the Indian River Lagoon system, Florida. Mar. Mamm. Sci. doi: 10.1111/j.1748-7692.2012.00575.x

Thompson, N.B. 1981. Estimates of abundance of *Tursiops truncatus* in Charlotte Harbor, Florida. NOAA/NMFS/SEFSC/Miami Laboratory, Fishery Data Analysis Technical Report. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Titcomb, E.M., G. O'Corry-Crowe, E.F. Hartel and M.S. Mazzoil. 2015. Social communities and spatiotemporal dynamics of association patterns in estuarine bottlenose dolphins. Mar. Mamm. Sci. 31(4):1314–1337.

Titcomb, E. Murdoch, J.S. Reif, P.A. Fair, Hui-Chen W. Stavros, M. Mazzoil, G.D. Bossart and A.M. Schaefer. 2017. Blood mercury concentrations in common bottlenose dolphins from the Indian River Lagoon, Florida: Patterns of social distribution. Mar. Mamm. Sci. 33(3):771–784.

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.

~~Wells, R.S., J.B. Allen, S. Hoffman, K. Bassos-Hull, D.A. Fauquier, N.B. Barros, R.E. DeLynn, G. Sutton, V. Socha and M.D. Scott. 2008. Consequences of injuries on survival and reproduction of common bottlenose dolphins (*Tursiops truncatus*) along the west coast of Florida. Mar. Mamm. Sci. 24: 774–794.~~

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1): 355–368.

~~Wells, R.S., S. Hofmann and T.L. Moors. 1998. Entanglement and mortality of bottlenose dolphins, *Tursiops truncatus*, in recreational fishing gear in Florida. Fish. Bull. 96(3): 647–650.~~

~~Wells, R.S. and M.D. Scott. 1994. Incidence of gear entanglement for resident inshore bottlenose dolphins near Sarasota, Florida. Pages 629 *in*: W.F. Perrin, G.P. Donovan and J. Barlow, (eds.) Gillnets and cetaceans. Rep. Int. Whal. Comm. Special Issue 15.~~

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.

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.

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*) Biscayne Bay 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 inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; 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). ~~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).~~

Figure 1. ***Geographic extent of the Biscayne Bay Stock. Dashed lines at Haulover Inlet and Card Sound Bridge denote the boundaries.***

Biscayne Bay is a shallow estuarine system located along the southeast coast of Florida in Miami-Dade county. The Bay is generally shallow (depths <5 m) and includes a diverse range of benthic communities including seagrass beds, soft coral and sponge communities, and mud flats. The northern portion of the Bay (Figure 1) is surrounded by the cities of Miami and Miami Beach and is therefore heavily influenced by industrial and municipal pollution sources. Furthermore, tidal flushing in this portion of the Bay is severely limited by the presence of dredged islands (Bialczak *et al.* 2001). In contrast, the central and southern portions of the Bay are less influenced by development and are better flushed. Water exchange with the Atlantic Ocean occurs through a broad area of grass flats and tidal channels termed the Safety Valve near the center of the Bay.

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

The Biscayne Bay Stock of common bottlenose dolphins has been the subject of an ongoing photo-ID study conducted by the NMFS Southeast Fisheries Science Center (SEFSC) since 1990. From 1990 to 1991, preliminary information was collected focusing on the central portion of the Bay. The survey was re-initiated in 1994, and it was expanded to include the northern portion of the Bay and south to the Card Sound Bridge in 1995 (~~SEFSC unpublished data;~~ Litz 2007). Photo-ID surveys were expanded further south through Barnes Sound to the Barnes Sound Bridge in 2008, and as of 2021, the photo-ID catalog contains more than 400 marked individuals. ~~Approximately 80%~~Many of these individuals are~~may be~~ long-term residents with multiple sightings over the course~~17 years~~ of the study (Litz *et al.* 2012~~SEFSC unpublished data~~). ~~Analyses of the sighting histories and associations of individuals from the Biscayne Bay photo-ID data demonstrated that there are at least two2 overlapping social groups of animals within Biscayne Bay segregated along a north/south gradient (Litz 2007).~~

Litz (2007) documented two social groups that differentially utilize habitats within Biscayne Bay; one group was sighted primarily in the northern half of the Bay while the other was sighted primarily in the southern half. Members of these two groups exhibited significant differences in contaminant loads (Litz *et al.* 2007). Evidence of weak but significant genetic differentiation was found between these two social groups using microsatellite data but not mitochondrial DNA (mtDNA) data (Litz *et al.* 2012). The lack of differentiation at mtDNA coupled with field observations indicating overlapping home ranges for these two groups suggests ongoing, though perhaps low, levels of interbreeding and the two groups have not been split into separate stocks at this time. However, significant genetic differentiation was found between Biscayne Bay and Florida Bay dolphins at both marker types (Litz *et al.* 2012). The observed genetic differences between resident animals in Biscayne Bay and those in an adjacent estuary combined with the high levels of ~~sight~~site fidelity observed, demonstrate that the resident Biscayne Bay common bottlenose dolphins are a demographically independent~~distinct~~ population ~~stock~~. Further work is needed to evaluate the degree of demographic independence between the two groups that utilize different habitats within the bay, given the evidence for a measurable level of nuclear genetic differentiation between them (Litz *et al.* 2012).

Biscayne Bay extends south through Card Sound and Barnes Sound, and connects through smaller inlets to Florida Bay (Figure 1). The Biscayne Bay Stock of common bottlenose dolphins is bounded by Haulover Inlet to the north and Card Sound bridge to the south. This range corresponds to the extent of confirmed home ranges of common bottlenose dolphins observed residing in Biscayne Bay by a long-term photo-ID study ~~conducted by the Southeast Fisheries Science Center~~ (Litz 2007~~; SEFSC unpublished data~~) and probably represents the core range of this stock. Preliminary comparisons of the Biscayne Bay catalog with catalogs from Florida Bay indicate there is spatial overlap of these two genetically distinct stocks near the stock boundary and/or within Barnes Sound. Thus, Biscayne Bay dolphins may utilize habitats outside these boundaries, including Barnes Sound, and so this southern boundary is subject to change upon further study. NMFS SEFSC has entered its catalog into the Gulf of Mexico Dolphin Identification System (GoMDIS; https://sarasotadolphin.org/gomdis/) to further investigate this possibility. ~~but there have been few surveys outside of this range. These boundaries are subject to change upon further study of dolphin home ranges within the Biscayne Bay estuarine system and comparison to an extant photo-ID catalog from Florida Bay to the south.~~

Dolphins residing within estuaries north of this stock to Jupiter Inlet are currently not included in any Stock Assessment Report. There are insufficient data to determine whether animals in this region exhibit affiliation to the Biscayne Bay Stock, the estuarine stock further to the north in the Indian River Lagoon Estuarine System (IRLES), or are simply transient animals associated with coastal stocks. There is relatively limited estuarine habitat along this coastline; however, the Intracoastal Waterway extends north along the coast to the IRLES. It should be noted that during 2016–2020~~2007–2011~~, there was one~~1~~ stranded common bottlenose dolphin in ~~this~~ unassigned estuarine habitat north of the Biscayne Bay Stock~~region in enclosed waters~~. There was evidence of human interaction for this stranding in the form of healed fishery interaction marks.~~It could not be determined if there were any signs of human interactions for this stranded animal.~~

POPULATION SIZE

The total number of common bottlenose dolphins residing within the Biscayne Bay Stock is unknown (Table 1).

Earlier abundance estimates (>8 years old)

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

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

Minimum Population Estimate

~~Present data are insufficient~~ No current information on abundance is available to calculate a minimum population estimate for the Biscayne Bay Stock of common bottlenose dolphins.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the Biscayne Bay Stock of common bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the Biscayne Bay Stock of common bottlenose dolphins is unknown (Table 1).

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

Nest	**CV ~~Nest~~**	**Nmin**	**Fr**	**Rmax**	**PBR**
Unknown	-	Unknown	0.5	0.04	Unknown

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the Biscayne Bay Stock during 2016–2020~~2007–2011~~ 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 0.6. Additional mean annual mortality and serious injury during 2016–2020 due to other human-caused sources was 0.2 (vessel strike). The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 0.8 (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, 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), and 5) a stranding with evidence of fishery-related interactions occurred in waters north of the Biscayne Bay Stock boundary that is not included within any stock, and the stranding could have been part of this stock (see Stock Definition and Geographic Range section).

~~No interactions with crab or lobster pot gear or hook and line gear were documented; however, it is not possible to estimate the total number of interactions or mortalities associated with crab or lobster pots or hook and line fisheries since there are no systematic observer programs.~~

~~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 are four commercial fisheries that interact, or that potentially could interact, with this stock. These include two Category II fisheries (Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot and Atlantic blue crab trap/pot) and two Category III fisheries (Florida spiny lobster trap/pot; and Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line)). Detailed fishery information is presented in Appendix III. ~~There is a potential for the Biscayne Bay Stock to interact with the Category II Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot fishery and the Category III Florida spiny lobster trap/pot fishery. This stock may also interact with the Category III Atlantic commercial passenger fishing vessel (hook and line) fishery (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.

Trap/Pot~~Crab and Lobster Pots~~

During 2016–2020~~2007-2011~~ there were two~~no~~ documented entanglement interactions~~mortalities or serious injuries~~ of common bottlenose dolphins in Biscayne Bay ~~associated with entanglement in~~with ~~crab and lobster~~ trap/pot fisheries. In 2020, one animal was disentangled from commercial blue crab trap/pot gear and released alive. Also in 2020, another animal was disentangled from unidentified trap/pot gear and released alive. For both cases, the animals were considered to be seriously injured following mitigation efforts (Maze-Foley and Garrison in prep). These live entanglements 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 18 November 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.~~Three mortalities were documented in prior years. One entanglement mortality was documented in 1997 in lobster pot gear just outside of the opening of the Bay to the Atlantic Ocean on the eastern edge of the Safety Valve area. In 2002, an entanglement mortality was observed in the central portion of the Bay in a stone crab pot. Finally, in 2006 there was an entanglement mortality of a known Biscayne Bay resident animal, also in a stone crab pot. This entanglement occurred in the northern portion of the Bay.~~

Hook and Line (Rod and Reel)~~Fisheries~~

~~There have been 2 mortalities of known resident Biscayne Bay bottlenose dolphins associated with ingestion and/or entanglement of recreational fishing gear including hooks and monofilament line. These mortalities occurred during 1990 and 1999.~~During 2016–2020 within the Biscayne Bay area, there was one documented interaction of a common bottlenose dolphin with ingested hook and line fishing gear. During 2018, there was one mortality where ~~for which~~ monofilament line was wrapped around the goosebeak and evidence suggested the hook and line gear contributed to the cause of death. This case was included in the annual human-caused mortality and serious injury total for this stock (Table 2), and it was included within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 18 November 2021).

It should be noted that, in general, it cannot be determined if rod and reel hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no observer program. The documented interaction in this gear represents a minimum known count of interactions in the last five years.

Other Mortality

During 2018, there was one mortality documented with wounds consistent with a vessel strike, and it was determined the mortality was due to the vessel strike. This mortality was included within the annual human-caused mortality and serious injury total for this stock (Table 2) as well as the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 18 November 2021).

All mortalities and serious injuries from known sources for the Biscayne Bay Stock are summarized in Table 2.

Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (*Tursiops truncatus*) of the Biscayne Bay 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**
Commercial Blue Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	1
Unidentified Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	1
Hook and Line	2016–2020	Stranding Data and At-Sea Observations	NA	1
Mean Annual Mortality due to commercial fisheries (2016–2020)			**0.6**	

Mean Annual Mortality due to other takes (2016–2020) (vessel strike)	**0.2**
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)	**0.8**

Strandings

During 2016–2020, nine common bottlenose dolphins were reported stranded within ~~There were 8 stranded animals occurring inside~~ Biscayne Bay ~~between 2007 and 2011~~ (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 18 November 2021~~13 September 2012~~). There was evidence of human interaction for four of the strandings. For the remaining five strandings, it could not be determined if there was evidence of human interaction. Human interactions were from entanglements with trap/pot gear, hook and line gear, and a vessel strike. 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.

~~One animal showed signs of human interactions in the form of propeller wounds, but these wounds may have occurred post-mortem. For 1 animal no evidence of human interactions was detected, and for the remaining 6 animals, it could not be determined if any human interactions had occurred.~~

Table 3. Common bottlenose dolphin strandings occurring in the Biscayne Bay 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**
Biscayne Bay Stock	Total Stranded	2	1	2	1	3	9
	HI--Yes	0	0	2[a]	0	2b	4
	HI--No	0	0	0	0	0	0
	HI--CBD	2	1	0	1	1	5

a. Includes 1 entanglement interaction with hook and line gear (mortality) and 1 mortality with evidence of a vessel strike.

b. Includes 1 entanglement interaction with commercial blue crab trap/pot gear and 1 entanglement interaction with unidentified trap/pot gear (both animals released alive, seriously injured).

HABITAT ISSUES

The nearshore and estuarine habitats occupied by dolphins in Biscayne Bay are adjacent to areas of high human population and some are highly industrialized. ~~Recent s~~Studies have examined persistent organic pollutant concentrations in common bottlenose dolphin tissues from several estuaries along the Atlantic coast and have likewise found evidence of high pollutant concentrations in blubber, particularly near Charleston, South Carolina, and Beaufort, North Carolina (Hansen *et al.* 2004). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). A study of persistent organic pollutants in common bottlenose dolphins of Biscayne Bay demonstrated a strong geographic gradient in pollutant concentrations between dolphins with sighting histories primarily in the northern, more polluted areas compared to dolphins with ranges in the southern portion of the Bay (Litz *et al.* 2007). The observed tissue concentrations of polychlorinated biphenyls (PCBs) for male animals from the northern Bay were five~~5~~ times higher than those in southern Biscayne Bay and were also higher than those of dolphins from other Atlantic estuaries including Beaufort, North Carolina, Charleston, South Carolina, Indian River Lagoon, Florida, and Florida Bay (Litz *et al.* 2007). These findings demonstrate differential exposure of common bottlenose dolphins to pollutants through the food chain on a very fine spatial scale within Biscayne Bay and between estuaries.

Eutrophication poses a threat to water quality throughout Biscayne Bay, especially in the northern portion of the bay. A twenty-year study (1995–2014) conducted within the bay found that concentrations of both chlorophyll a and phosphates increased throughout the bay, with concentrations increasing at a higher rate in northern Biscayne Bay (Millette *et al.* 2019). Their findings coupled with recent seagrass die-offs, fish kills due to low levels of dissolved oxygen, and harmful algal blooms, indicate water quality is declining (Millette *et al.* 2019).

STATUS OF STOCK

Common ~~B~~bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act, and the Biscayne Bay Stock is not a strategic stock under the MMPA. ~~However, because the abundance of the Biscayne Bay 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 Marine Mammal Protection Act.~~ The documented mean annual human-caused mortality for this stock for 2016–2020 was 0.8. However, it is likely the estimate of annual fishery-caused mortality and serious injury is biased low as indicated above (see Annual Human-Caused Mortality and Serious Injury section). 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 and uncertainty as to the level of demographic independence between two groups of dolphins that utilize different habitats within the bay. The status of this stock relative to optimum sustainable population is unknown. There are insufficient data to determine population trends for this stock. ~~There are no documented human-caused mortalities for this stock for 2007 – 2011, although entanglements in lobster and crab pot fisheries and in hook and line fisheries have been documented in prior years. There are several commercial fisheries operating within this stock's boundaries and these fisheries have little to no observer coverage. 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.~~

REFERENCES CITED

~~Andersen, M.S., K.A. Forney, T.V.N. Cole, T. Eagle, R. Angliss, K. Long, L. Barre, L. Van Atta, D. Borggaard, T. Rowles, B. Norberg, J. Whaley and L. Engleby. 2008. Differentiating serious and non-serious injury of marine mammals: report of the serious injury technical workshop, 10-13 September 2007, Seattle, WA. NOAA Tech. Memo. NMFS-OPR-39. 94 pp.~~

~~Angliss, R.P. and D.P. DeMaster. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: Report of the serious injury workshop, 1-2 April 1997, Silver Spring, MD. NOAA Tech. Memo. NMFS-OPR-13. 48 pp.~~

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.

Bialczak, M., J.R. Murley and L. Cantral. 2001. Biscayne Bay Partnership Initiative; survey team final reports. Miami, FL 320 pp.

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112:1–23.

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

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

Gubbins, C. 2002. Association patterns of resident bottlenose dolphins (*Tursiops truncatus*) in a South Carolina estuary. Aquat. Mamm. 28(1):24–31.

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 Environ. 319:147–172.

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.

Litz, J.A., L.P. Garrison, L.A. Fieber, A. Martinez, J.P. Contillo and J.R. Kucklick. 2007. Fine scale spatial variation of persistent organic pollutants in bottlenose dolphins (*Tursiops truncatus*) in Biscayne Bay, Florida. Env. Sci. and Tech. 41(21):7222–7228.

Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1):107–117.

Maze-Foley, K. and L.P. Garrison. in prep. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2022-XX. XX pp. Available from:

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

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.

Millette, N.C., C. Kelble, A. Linhoss, S. Ashby and L. Visser. 2019. Using spatial variability in the rate of change of chlorophyll a to improve water quality management in a subtropical oligotrophic estuary. Estuaries and Coasts (2019) 42:1792–1803.

~~Moore, J.C. 1953. Distribution of marine mammals to Florida waters. Am. Midl. Nat. 49: 117–157.~~

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available at: http://www.nmfs.noaa.gov/op/pds/index.html

~~NOAA. 2012. Federal Register 77:3233. National policy for distinguishing serious from non-serious injuries of marine mammals. Available from: http://www.nmfs.noaa.gov/op/pds/documents/02/238/02-238-01.pdf~~

Odell, D.K. 1979. A preliminary study of the ecology and population biology of the bottlenose dolphin in Southeast Florida; Final report to the Marine Mammal Commission in fulfillment of contract MM4AC003. Miami, FL: University of Miami.

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18:278–290.

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Molec. Ecol. 18:5030–5045.

Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded common bottlenose dolphins in southeastern Louisiana after the Deepwater Horizon oil spill. Endang. Species Res. 33:221–234.

Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Environ. Toxicol. Chem. 21(12):2752–2764.

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.

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.

~~Wells, R.S. and M.D. Scott. 1999. Bottlenose dolphins. Pages 137-182 *in*: S.H. Ridgway and R. Harrison, (eds.) Handbook of marine mammals. Vol. 6: The second book of dolphins and the porpoises. Academic Press, San Diego, CA.~~

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 Mammology, Vol. 1. Plenum Press, New York. Vol. 1.

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1):355–368.

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(4): 879–892.

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*)
Florida Bay 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 inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; 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).~~

Common bottlenose dolphins are distributed throughout the bays, sounds, and estuaries (BSE) of the Gulf of Mexico (Mullin 1988). Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every estuarine site where photographic identification (photo-ID) or tagging studies have been conducted in the Gulf of Mexico (e.g., Irvine and Wells 1972; Shane 1977; Gruber 1981; Irvine *et al.* 1981; Wells 1986; Wells *et al.* 1987; Scott *et al.* 1990; Shane 1990; Wells 1991; Bräger 1993; Bräger *et al.* 1994; Fertl 1994; Wells *et al.* 1996a,b; Wells *et al.* 1997; Weller 1998; Maze and Würsig 1999; Lynn and Würsig 2002; Wells 2003; Hubard *et al.* 2004; Irwin and Würsig 2004; Shane 2004; Balmer *et al.* 2008; Urian *et al.* 2009; Bassos-Hull *et al.* 2013; Wells *et al.* 2017; Balmer *et al.* 2018). In many cases, residents occur predominantly within estuarine waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; Gruber 1981; Irvine *et al.* 1981; Shane 1990; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006; Bassos-Hull *et al.* 2013; Wells *et al.* 2017).

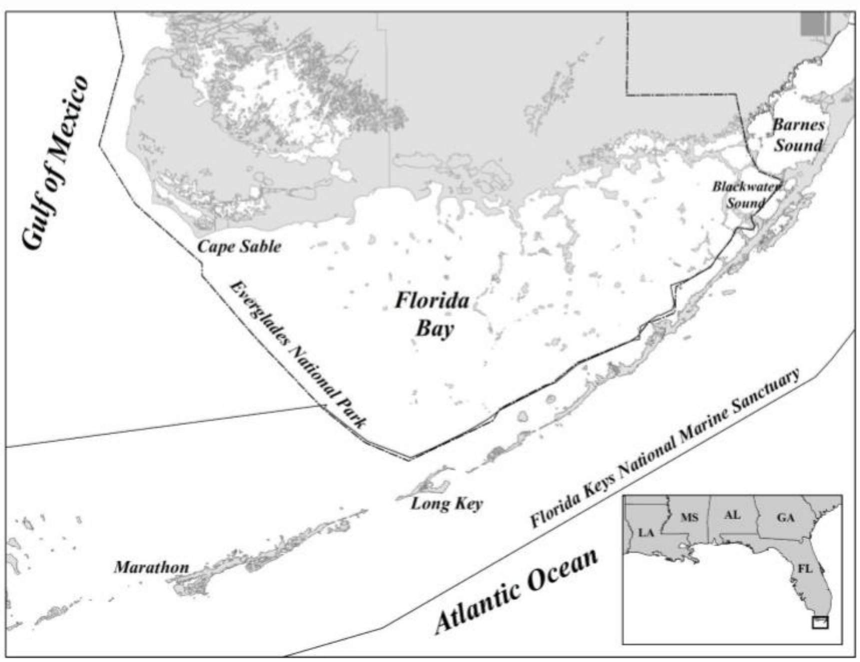


Figure 1. ***Geographic extent of the Florida Bay Stock. The boundaries of Everglades National Park and Florida Keys National Marine Sanctuary are shown.***

Genetic data also support the concept of relatively discrete, demographically independent BSE populations in the Gulf of Mexico (Duffield and Wells 2002; Sellas *et al.* 2005; Rosel *et al.* 2017). Sellas *et al.* (2005) examined population subdivision among dolphins sampled in Sarasota Bay, Tampa Bay, and Charlotte Harbor, Florida; Matagorda Bay, Texas; and the coastal Gulf of Mexico (1–12 km offshore) from just outside Tampa Bay to the south end of Lemon Bay, and found evidence of significant genetic population differentiation among all areas. Genetic data also indicate restricted genetic exchange between and demographic independence of BSE populations and those occurring in adjacent Gulf coastal waters (Sellas *et al.* 2005; Rosel *et al.* 2017). Photo-ID and genetic data from several inshore areas of the southeastern United States Atlantic coast also support the existence of resident estuarine animals and differentiation between animals biopsied along the Atlantic coast and those biopsied within estuarine systems at the same latitude (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; Litz 2007; Rosel *et al.* 2009).

Florida Bay is a shallow estuarine system ~~that lies between the mainland of Florida and the Florida Keys and~~ that encompasses 2,200 km2 of interconnected basins, grassy mud banks and mangrove islands. Florida Bay is bordered by the Florida mainland to the north, by the Florida Keys and Atlantic Ocean to the southeast, and by the Gulf of Mexico to the west. The western boundary of the Everglades National Park is generally considered to be the boundary between Florida Bay and the Gulf of Mexico. Here, Barnes Sound is not considered to be part of Florida Bay (Figure 1). Florida Bay was historically fed by runoff from the Everglades through marsh-like prairies called sloughs and a number of nearby creeks or inlets. The Bay connects through smaller inlets to Biscayne Bay, between Blackwater Sound and Barnes Sound. Freshwater flow from the Everglades is a major influence on the conditions within the Bay, particularly since tides have little effect on water levels due to mud banks that restrict water flow (Fourqurean and Robblee 1999).

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

During 1995–~~-~~1997, aerial surveys were conducted in Florida Bay to census bird populations, and opportunistic sightings of common bottlenose dolphins were recorded. While these surveys did not estimate the abundance of common bottlenose dolphins, the surveys documented the presence of dolphins in Florida Bay throughout the year (McClellan *et al.* 2000). Engleby *et al.* (2002) also recorded dolphins year round in a photo-ID study performed during 1999–2000 with the majority of sightings in the southern portion of the bay. Torres (2007) conducted surveys during summers (June–August) from 2002 to 2005 and found that dolphins were present in all areas of the Bay. Sarabia *et al.* (2018) recorded dolphins in northern Florida Bay from Cape Sable to Flamingo, Florida. Biopsy sampling was conducted in 1998 and 2002 for contaminant analyses (Fair *et al.* 2003). Sub-samples were later used for genetic analysis which revealed significant genetic differentiation between Florida Bay and Biscayne Bay to the northeast (Litz *et al.* 2012). There is insufficient information to determine whether the Florida Bay stock comprises multiple demographically independent populations.

~~Dolphins in Florida Bay have been the subject of an ongoing photo-ID study by the Dolphin Ecology Project since 1999. From 1999 to 2000, preliminary information was collected focusing on the eastern, Atlantic, and central areas of the Bay, and in 2001 the surveys were expanded to include the western portion of the Bay including the region of transition to the Gulf of Mexico. Typically, photo-ID surveys were conducted during the 2 seasons of most extreme rainfall levels in Florida Bay, summer (the wet season, May-October) and winter (the dry season, November-April), allowing for the assessment of seasonal variation in the distribution of dolphins (Engleby et al. 2002). Surveys were conducted by a small vessel using standard photo-ID methods. Through 2007, the photo-ID catalog included 577 unique individuals. Sighting data confirm that dolphins range throughout the Bay and are present year-round (Engleby, unpublished data.)During the summer (June-August) from 2002 to 2005, a study to investigate top predator (sharks and dolphins) distribution and foraging ecology was conducted in Florida Bay. The sighting histories of 437 unique individual dolphins further confirmed that dolphins are present in all areas of the Bay and demonstrate high individual site and foraging tactic fidelity (Torres 2007).~~ The Florida Bay resident stock of common bottlenose dolphins is considered to occur both within the bounds of Florida Bay and within the Gulf of Mexico-side portion of the Florida Keys National Marine Sanctuary (FKNMS) southwest to Marathon, Florida (Figure 1). The western boundary of the stock area follows the COLREGs line from Cape Sable in the north to the west side of Long Key in the south. The ~~actual~~ range of the resident animals is unknown~~, but it likely extends beyond the boundaries of Florida Bay at times~~. ~~For example, the range of Florida Bay dolphins may extend north into Barnes Sound; however, there have been few surveys of this area. A preliminary comparison of the Biscayne Bay and Florida Bay photo-ID catalogs revealed 13 matched animals with approximately 25% of these matched animals documented only near the Barnes Sound boundary between Florida Bay and Biscayne Bay (NMFS unpublished data; Dolphin Ecology Project unpublished data). This initial comparison suggests there may be some spatial overlap of these two genetically distinct stocks at the stock boundary.~~ There is evidence~~It is also likely~~ that transient animals occur within the Florida Bay boundaries, including

~~perhaps~~ offshore morphotype animals that move onshore from nearby oceanic waters (Litz *et al.* 2012), although the frequency of this occurrence is unknown. The boundaries for the Florida Bay Stock are subject to change upon further study of dolphin home ranges within the Florida Bay estuarine system.

POPULATION SIZE

The total number of common bottlenose dolphins residing within the Florida Bay Stock is unknown (Table 1).~~Population size estimates for this stock are greater than 8 years old and therefore the current population size for the stock is considered unknown (Wade and Angliss 1997).~~

Earlier abundance estimates (>8 years old)

~~The first mark-recapture abundance survey of bottlenose dolphins in Florida Bay was conducted during May 2003 using photo-ID methods (Read *et al.*, in review). This survey resulted in a best estimate for abundance of common bottlenose dolphins in Florida Bay of 514 (CV=0.17; Read *et al.*, in review). This estimate accounts for the proportion of the population with unmarked fins.~~ From November 1998 to June 2002, year-round surveys were conducted in Florida Bay, documenting 230 unique individuals (Engleby and Powell 2019). Torres (2007) conducted surveys of Florida Bay in the summers of 2002 through 2005 and ~~The mark-recapture abundance estimate is comparable to a direct count of known individuals from a long-term photo-ID catalog (n=577) and work by Torres (2007), which~~ documented 437 unique individuals ~~during summer months~~. However, neither of these counts~~Each of these counts or estimates of population sizedoeseffectively~~ distinguished resident from non-resident animals in the Bay and so may be~~isare likely~~ overestimates of the number of resident animals~~population~~.

Minimum Population Estimate

No current information on abundance is available to calculate a minimum population estimate for the Florida Bay Stock of common bottlenose dolphins.~~Present data are insufficient to calculate a minimum population estimate for the Florida Bay Stock of bottlenose dolphins~~.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

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

Nest	CV Nest	Nmin	Fr	Rmax	PBR
Unknown	-	Unknown	0.5	0.04	Unknown

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the Florida Bay 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 0.2. No additional mortality or serious injury was documented from other human-caused sources. The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 0.2 (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, especially in an area such as Florida Bay where human inhabitation of the shoreline is sparse (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).

~~There was 1 documented report of a fishery-related mortality or serious injury to this stock between 2007 and 2011. The report was an at-sea observation of a dolphin seriously injured due to an interaction with the hook and line fishery (Maze-Foley and Garrison in prep.).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.~~

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.

Fishery Information

There are three commercial fisheries that interact, or that potentially could interact, with this stock. These include one Category II fishery (Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot) and two Category III fisheries (Florida spiny lobster trap/pot; and Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line)). Detailed fishery information is presented in Appendix III.

Most of Florida Bay lies within the boundaries of the Everglades National Park with a smaller portion that lies within the FKNMS. Commercial fishing in the Everglades National Park is prohibited. The majority of recreational fishing is hook and line, although ~~dip nets,~~ cast nets ~~and landing nets~~ are also used. ~~The predominant commercial fishery in the FKNMS is stone crab and spiny lobster. The Florida Bay Stock has the potential to interact with the Category II Florida spiny lobster trap/pot and Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot fisheries and the Category III Atlantic commercial passenger fishing vessel (hook and line) fishery.~~

~~Crab and Lobster~~ Trap/Pot~~s~~

During 2016–2020, there were two documented entanglement interactions of common bottlenose dolphins in Florida Bay associated with trap/pot fisheries. In 2017, one animal was disentangled from both commercial stone crab trap/pot gear and commercial spiny lobster trap/pot gear and released alive. In 2020, one animal was disentangled from commercial stone crab trap/pot gear and released alive. For both cases, it could not be determined (CBD) if the animals were seriously injured following mitigation efforts (the initial determinations were seriously injured for both (Maze-Foley and Garrison in prep). The two CBD cases were prorated based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison in prep) and 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 and lobster trap/pot fisheries. The documented interactions in this gear represent a minimum known count of interactions in the last five years.~~There are no documented mortalities or serious injuries of bottlenose dolphins in crab or lobster pot fisheries in Florida Bay between 2007 and 2011. During 2003, 1 bottlenose dolphin was reported entangled in a lobster pot in the southern, FKNMS portion of Florida Bay. The animal was disentangled and released alive, but due to its condition had to be taken shortly thereafter to rehab. It was re-released 2 weeks later. Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab and lobster pots.~~

Hook and Line (Rod and Reel)~~Fishery~~

During 2016–2020, there were no documented mortalities or serious injuries of common bottlenose dolphins involving hook and line gear entanglement or ingestion. The most recent documented interaction with this fishery was a serious injury that occurred in 2011. It is not possible to estimate the total number of interactions with hook and line gear because there is no observer program. ~~During 2007-2011, there was 1 at-sea observation (in 2011) of a bottlenose dolphin entangled in monofilament line which was cutting off nearly half of its dorsal fin and trailing behind the animal. This animal was considered seriously injured (Maze-Foley and Garrison in prep.).~~

Other Mortality

There were no additional documented mortalities or serious injuries besides those described in the crab and lobster pots section above. All mortalities and serious injuries from known sources for the Florida Bay Stock are summarized in Table 2.

Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (*Tursiops* truncatus) of the Florida Bay 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**
Commercial Stone Crab and Commercial Spiny Lobster Trap/Pot (both gear types)	2016–2020	Stranding Data and At-Sea Observations	NA	0.5*[a]
Commercial Stone Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	0.5*a
Hook and Line	2016–2020	Stranding Data and At-Sea Observations	NA	0
Mean Annual Mortality due to commercial fisheries (2016–2020)			**0.2**	
Mean Annual Mortality due to other takes (2016–2020)			**0**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)			**0.2**	

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

0.5).

Strandings

During 2016–2020, 14 common bottlenose dolphins were reported stranded~~From 2007 to 2011, there were 5 stranded bottlenose dolphins~~ within the boundaries of the Florida Bay Stock (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021~~13 September 2012~~). Evidence of human interaction was found for ~~1~~two animals~~ in the form of an old propeller scar~~. For the remaining 12~~4~~ animals, it could not be determined if there was evidence of human interactions. The two human interactions were from entanglements with trap/pot gear as described above. 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.

The majority of stranding reports came from the portion of Florida Bay contained within the FKNMS, likely associated with the higher human population in this area and thus, a higher likelihood of a stranding being discovered and reported. ~~Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fishery interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.~~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.

Table 3. Common bottlenose dolphin strandings occurring in the Florida Bay 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
Florida Bay Stock	Total Stranded	4	2	2	4	2	14
	HI--Yes	0	1[a]	0	0	1[b]	2
	HI--No	0	0	0	0	0	0
	HI--CBD	4	1	2	4	1	12

a. An entanglement interaction with commercial stone crab and commercial spiny lobster trap/pot gear (released alive, CBD if seriously injured).

b. An entanglement interaction with commercial stone crab trap/pot gear (released alive, CBD if seriously injured).

HABITAT ISSUES

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

There is some concern about the potential effect of contaminants on the health of common bottlenose dolphins in Florida Bay, due to their proximity to large agricultural and industrial operations. Contaminants of concern include persistent organic pollutants and heavy metals such as mercury. The agricultural pesticide endosulfan is of particular concern, with the majority (76%) of endosulfan used in the southeast discharging into the Everglades and Florida Bay watershed (Pait *et al.* 1992). A study in 2003 collected remote biopsy samples and provided the first baseline data on levels of exposure to toxic persistent organic contaminants for dolphins in Florida Bay. Pesticides such as endosulfan were found at low or non-detectable concentrations (Fair *et al.* 2003). A review of available organochlorine exposure data from both dart biopsy and live-capture health assessment studies along the southeast U.S. coast indicate that contaminant levels were lowest for dolphins sampled in Florida Bay when compared to all other sites in the southeast U.S. Measured concentrations of total DDTs were lowest for dolphins sampled in Florida Bay. Reported total PCB concentrations were also lowest in Florida Bay and this was the only location in the southeast where samples fell below the toxic threshold value for total PCBs (Schwacke *et al.* 2004). Damseaux *et al.* (2017) confirmed persistent organic pollutant levels in common bottlenose dolphins from the Florida Coastal Everglades (FCE) were low compared to other populations of common bottlenose dolphins in the southeast U.S. However, the total mercury concentrations from male dolphins in the FCE were higher than other locations in Florida, such as the Florida Keys, Sarasota Bay, and the Indian River Lagoon (Damseaux *et al.* 2017). Although the effects of mercury on dolphins are unknown (see Kershaw and Hall 2019 for a review), high mercury concentrations from the FCE including Florida Bay raise concerns about potential health impacts on common bottlenose dolphins (Damseaux *et al.* 2017). There are no estimates of indirect human-caused mortality from pollution or habitat degradation.

STATUS OF STOCK

Common ~~B~~bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act, and the Florida Bay Stock is not considered strategic under the MMPA~~Marine Mammal Protection Act~~.The documented mean annual human-caused mortality for this stock for 2016–2020 was 0.2. 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). ~~NMFS has concern for this stock because the abundance of the stock is currently unknown but likely small, and relatively few mortalities and serious injuries would exceed PBR There are no documented human-caused mortalities to this stock for 2007 – 2011. There are commercial crab and lobster trap/pot fisheries operating within the boundaries of this stock but the level of fishing effort is low and few animals strand with evidence of fishery interactions.~~ 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 optimum sustainable population~~OSP~~ is unknown. There are insufficient data to determine the population trends for this stock.

REFERENCES CITED

~~Andersen, M.S., K.A. Forney, T.V.N. Cole, T. Eagle, R. Angliss, K. Long, L. Barre, L. Van Atta, D. Borggaard, T. Rowles, B. Norberg, J. Whaley and L. Engleby. 2008. Differentiating serious and non-serious injury of marine mammals: report of the serious injury technical workshop, 10-13 September 2007, Seattle, WA. NOAA Tech. Memo. NMFS-OPR-39. 94 pp.~~

~~Angliss, R.P. and D.P. DeMaster. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: Report of the serious injury workshop, 1-2 April 1997, Silver Spring, MD. NOAA Tech. Memo. NMFS-OPR-13. 48 pp.~~

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.

Balmer, B.C., T. McDonald, F. Hornsby, J. Adams, J. Allen, A. Barleycorn, P. Clarke, C. Cush, A. Honaker, K. McHugh, T. Speakman, R. Wells and L. Schwacke. 2018. Long-term trends in a northern Gulf of Mexico common bottlenose dolphin (*Tursiops truncatus*) population in the wake of the Deepwater Horizon oil spill. J. Cetacean Res. Manage. 18:1–9.

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.

Bassos-Hull, K., R.M. Perrtree, C.C. Shepard, S. Schilling, A.A. Barleycorn, J.B. Allen, B.C. Balmer, W.E. Pine and R.S. Wells. 2013. Long-term site fidelity and seasonal abundance estimates of common bottlenose dolphins (*Tursiops truncatus*) along the southwest coast of Florida and responses to natural perturbations. J. Cetacean Res. Manage. 13(1):19–30.

Bräger, S. 1993. Diurnal and seasonal behavior patterns of bottlenose dolphins (*Tursiops truncatus*). Mar. Mamm. Sci. 9(4):434–440.

Bräger, S., B. Würsig, A. Acevedo and T. Henningsen. 1994. Association patterns of bottlenose dolphins (*Tursiops truncatus*) in Galveston Bay, Texas. J. Mamm. 75(2):431–437.

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112(1):1–23.

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

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

Damseaux, F., J.J. Kiszka, M.R. Heithaus, G. Scholl, G. Eppe, J. Thome, J. Lewis, W. Hao, M.C. Fontaine and K. Das. 2017. Spatial variation in the accumulation of POPs and mercury in bottlenose dolphins of the Lower Florida Keys and the coastal Everglades (South Florida). Environmental Pollution 220:577–587.

Duffield, D.A. and R.S. Wells 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. Pages 3–11 in: C. J. Pfeiffer, (ed.) Cell and Molecular Biology of Marine Mammals. Krieger Publishing, Melbourne, FL.

Engleby, L.K. and J.R. Powell. 2019. Detailed observations and mechanisms of mud ring feeding by common bottlenose dolphins (*Tursiops truncatus truncatus*) in Florida Bay, Florida, USA. Mar. Mamm. Sci. 35(3): 1162–1172.

Engleby, L.K., A.J. Read, D. Waples and L. Torres. 2002. Habitat use of bottlenose dolphins (*Tursiops truncatus*) in Florida Bay. Final Report to the Southeast Fisheries Science Center, National Marine Fisheries Service, 12 pp.

Fair, P., L. Schwacke, E. Zolman, W. McFee and L. Engleby. 2003. Assessment of contaminant concentrations in tissues of bottlenose dolphins (*Tursiops truncatus*) in Florida Bay. Harbor Branch Oceanographic Institute Protect Wild Dolphins Grant. RFP-PWD-2001. Final report 18 pp.

Fazioli, K.L., S. Hoffman and R.S. Wells. 2006. Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus*). Aquat. Mamm. 32(2):212–222.

Fertl, D.C. 1994. Occurrence patterns and behavior of bottlenose dolphins (*Tursiops truncatus*) in the Galveston ship channel. Texas J. Sci. 46:299–317.

Fourqurean, J.W. and M.B. Robblee. 1999. Florida Bay: A history of recent ecological changes. Estuaries 22(2B).

Gruber, J.A. 1981. Ecology of the Atlantic bottlenosed dolphin (*Tursiops truncatus*) in the Pass Cavallo area of Matagorda Bay, Texas. M. Sc. thesis from Texas A&M University, College Station. 182 pp.

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

Hubard, C.W., K. Maze-Foley, K.D. Mullin and W.W. Schroeder 2004. Seasonal abundance and site fidelity of bottlenose dolphins (*Tursiops truncatus*) in Mississippi Sound. Aquat. Mamm. 30:299–310.

Irvine, B. and R.S. Wells. 1972. Results of attempts to tag Atlantic bottlenose dolphins (*Tursiops truncatus*). Cetology 13:1–5.

Irvine, A.B., M.D. Scott, R.S. Wells and J.H. Kaufmann 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. Fish. Bull. 79:671–688.

Irwin, L.J. and B. Würsig 2004. A small resident community of bottlenose dolphins, *Tursiops truncatus*, in Texas: Monitoring recommendations. G. Mex. Sci. 22(1):13–21.

Kershaw, J.L. and A.J. Hall. 2019. Mercury in cetaceans: Exposure, bioaccumulation and toxicity. Sci. Total Environ. 694:133683.

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

Litz, J.A., C.R. Hughes, L.P. Garrison, L.A. Fieber and P.E. Rosel. 2012. Genetic structure of common bottlenose dolphins (*Tursiops truncatus*) inhabiting adjacent South Florida estuaries - Biscayne Bay and Florida Bay. J. Cetacean Res. Manage. 12(1): 107-117.

Lynn, S.K. and B. Würsig 2002. Summer movement patterns of bottlenose dolphins in a Texas bay. Gulf Mex. Sci. 20(1):25–37.

Maze, K.S. and B. Würsig 1999. Bottlenose dolphins of San Luis Pass, Texas: Occurrence patterns, site fidelity, and habitat use. Aquat. Mamm. 25:91–103.

Maze-Foley, K. and L.P. Garrison. in prep. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2022-XX. XX pp.

Maze-Foley, K., B.L. Byrd, S.C. Horstman and J.R. Powell. 2019. Analysis of stranding data to support estimates of mortality and serious injury in common bottlenose dolphin (*Tursiops truncatus truncatus*) stock assessments for the Atlantic Ocean and Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-742. 42 pp. Available from: https://repository.library.noaa.gov/view/noaa/23151

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. Fla. Sci. 68(4): 217-226.

McClellan, D.B., J.A. Browder, J.L. Tobias, G.J. Konoval, M.D. Hearon, O. Bass and J. Osborne. 2000. Opportunistic sightings of bottlenose dolphin, *Tursiops truncatus*, along the southeast Florida coast and Florida Bay, 1992-1997. NOAA Tech. Memo. NMFS-SEFSC-435. 18 pp.

Mullin, K.D. 1988. Comparative seasonal abundance and ecology of bottlenose dolphins (*Tursiops truncatus*) in three habitats of the north-central Gulf of Mexico. Ph.D. thesis. Mississippi State University, Starkville. 135 pp.

NMFS 2012. Process for distinguishing serious from non-serious injury of marine mammals: Process for injury determinations. National Marine Fisheries Service Policy Directive PD 02-038-01. January 2012. Available from: http://www.nmfs.noaa.gov/pr/laws/mmpa/policies.htm [Federal Register Notice, Vol. 77, No. 14, page 3233, January 23, 2012]

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. Available at: http://www.nmfs.noaa.gov/op/pds/index.html

~~NOAA. 2012. Federal Register 77:3233. National policy for distinguishing serious from non-serious injuries of marine mammals. Available from: http://www.nmfs.noaa.gov/op/pds/documents/02/238/02-238-01.pdf~~

Pait, A.S., A.E. DeSouza and D.R. Farrow. 1992. Agricultural pesticide use in coastal areas: A national summary. Strategic Environmental Assessments Division, Office of Ocean Resources Conservation and Assessment, NOS, NOAA. 112 pp.

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18:278–290.

~~Read, A.J., K.W. Urian, L.K. Engleby, D.M. Waples and B. Wilson in review. Abundance of bottlenose dolphins in Florida Bay. Bulletin of Marine Science.~~

Rosel, P.E., L. Hansen and A.A. Hohn. 2009. Restricted dispersal in a continuously distributed marine species: common bottlenose dolphins *Tursiops truncatus* in coastal waters of the western North Atlantic. Molec. Ecol. 18: 5030–5045.

Rosel, P.E., L.A. Wilcox, C. Sinclair, T.R. Speakman, M.C. Tumlin, J.A. Litz and E.S. Zolman. 2017. Genetic assignment to stock of stranded bottlenose dolphins in southeastern Louisiana after the Deepwater Horizon oil spill. Endang. Species Res. 33:221–234.

Sarabia, R. E., M.R. Heithaus, and J.J. Kiszka,. 2018. Spatial and temporal variation in abundance, group size and behaviour of bottlenose dolphins in the Florida coastal Everglades. J. Mar. Biolog. Assoc. 98:1097–1107.

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, M.D., R.S. Wells and A.B. Irvine 1990. A long-term study of bottlenose dolphins on the west coast of Florida. Pages 235-244 in: S. Leatherwood and R.R. Reeves, (eds.) The bottlenose dolphin. Academic Press, San Diego, CA.

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. Conserv. Genet. 6(5): 715-728.

Shane, S.H. 1977. The population biology of the Atlantic bottlenose dolphin, *Tursiops truncatus*, in the Aransas Pass area of Texas. M. Sc. thesis from Texas A&M University, College Station. 238 pp.

Shane, S.H. 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. Pages 245–265 in: S. Leatherwood and R.R. Reeves, (eds.) The bottlenose dolphin. Academic Press, San Diego, CA.

Shane, S.H. 2004. Residence patterns, group characteristics, and association patterns of bottlenose dolphins near Sanibel Island, Florida. G. Mex. Sci. 22(1):1–12.

Torres, L.G. 2007. Top predator distribution and foraging ecology in Florida Bay. Ph.D. thesis. Duke University. 225 pp.

Torres, L.G. and D. Urban 2005. Using spatial analysis to assess bottlenose dolphins as an indicator of healthy fish habitat. Pages 423-436 *in*: S. A. Bortone, (ed.) Estuarine indicators. CRC Press, Boca Raton, FL.

Urian, K.W., S. Hofmann, R.S. Wells and A.J. Read. 2009. Fine-scale population structure of bottlenose dolphins (*Tursiops truncatus*) in Tampa Bay, Florida. Mar. Mamm. Sci. 25(9):619–638.

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.

Weller, D.W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph. D. thesis from Texas A&M University, College Station. 142 pp.

Wells, R.S. 1986. Population structure of bottlenose dolphins: Behavioral studies along the central west coast of Florida. Contract report to NMFS, SEFSC. Contract No. 45-WCNF-5-00366. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149. 58 pp.

Wells, R.S. 1991. The role of long-term study in understanding the social structure of a bottlenose dolphin community. Pages 199–225 in: K. Pryor and K. S. Norris, (eds.) Dolphin societies: Discoveries and puzzles. University of California Press, Berkeley.

Wells, R.S. 2003. Dolphin social complexity: Lessons from long-term study and life history. Pages 32-56 in: F. B. M. de Waal and P. L. Tyack, (eds.) Animal social complexity: Intelligence, culture, and individualized societies. Harvard University Press, Cambridge, MA.

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 Mammology, Vol. 1. Plenum Press, New York. Vol. 1.

Wells, R.S., M.K. Bassos, K.W. Urian, W.J. Carr and M.D. Scott 1996a. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Charlotte Harbor, Florida: 1990-1994. NOAA Tech. Memo. NMFS-SEFSC-384. 36 pp.

Wells, R.S., K.W. Urian, A.J. Read, M.K. Bassos, W.J. Carr and M.D. Scott 1996b. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC-385. 25 pp.

Wells, R.S., M.K. Bassos, K.W. Urian, S.H. Shane, E.C.G. Owen, C.F. Weiss, W.J. Carr and M.D. Scott 1997. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Pine Island Sound, Florida: 1996. Contract report to National Marine Fisheries Service, Southeast Fisheries Center Contribution No. 40-WCNF601958. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1):355–368.

Wells, R.S., L.H. Schwacke, T.K. Rowles, B.C. Balmer, E. Zolman, T. Speakman, F.I. Townsend, M.C. Tumlin, A. Barleycorn and K.A. Wilkinson. 2017. Ranging patterns of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, following the Deepwater Horizon oil spill. Endanger. Spec. Res. 33:159–180.

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(4): 879-892.

~~BRYDE~~RICE'S WHALE (*Balaenoptera ricei~~edeni~~*):
Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Rice's whales are medium-sized baleen whales closely related to Bryde's whales and sei whales ~~Bryde's whales are distributed worldwide in tropical and sub-tropical waters. The taxonomy and number of species and/or subspecies of Bryde's whales in the world is currently a topic of debate (Kato and Perrin 2008;~~ (Rosel and Wilcox 2014; Rosel *et al.* 2021). Rice's whales were identified as a unique evolutionary lineage and given species status in 2021 (Rosel *et al.* 2021). The species has a relatively restricted range within the northern Gulf of Mexico, although further research is ongoing to evaluate other potentially suitable habitat in the western and southern Gulf of Mexico. ~~In the western Atlantic Ocean, Bryde's whales are reported from the Gulf of Mexico and the southern West Indies to Cabo Frio, Brazil (Leatherwood and Reeves 1983).~~ Sighting records and acoustic detections of Rice's~~Bryde's~~ whales in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) occur primarily~~almost exclusively~~ in the northeastern Gulf in the De Soto Canyon area, along the continental shelf break between 100 m and 400 m depth, with a single sighting at 408 m (Figure 1; Hansen *et al.* 1996; Mullin and Hoggard 2000; Mullin and Fulling 2004; Maze-Foley and Mullin 2006; Rice *et al.* 2014; Rosel and Wilcox 2014; Širović *et al.* 2014; Rosel *et al.* 2016; Soldevilla *et al.* 2017). Rice's~~Bryde's~~ whales have been sighted in all seasons within the De Soto Canyon area (Mullin and Hoggard 2000; Maze-Foley and Mullin 2006; Mullin 2007; DWH MMIQT 2015). ~~Genetic analysis suggests that Bryde's whales from the northern Gulf of Mexico represent a unique evolutionary lineage distinct from other recognized Bryde's whale subspecies,~~

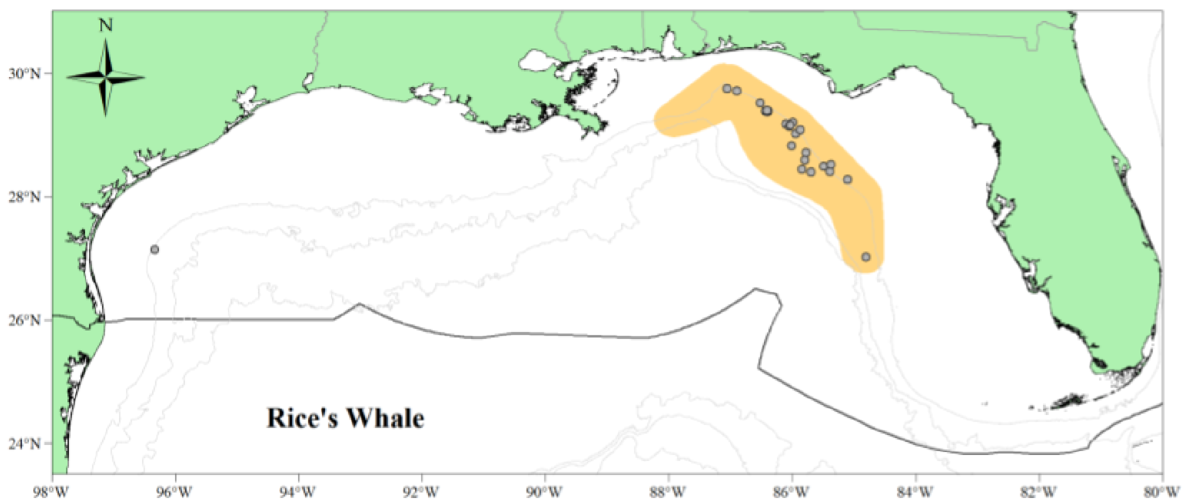


Figure 1. Distribution of all Rice's whale sightings from SEFSC vessel surveys during spring 1996–2001, summer 2003, spring 2004, summer 2009, summer 2017, and summer/fall 2018. Isobaths are the 200-m, 1,000-m, and 2,000-m depth contours. The darker line indicates the U.S. EEZ. The shaded area indicates the core habitat.

~~including those found in the southern Caribbean and southwestern Atlantic off Brazil (Rosel and Wilcox 2014). The geographic distribution of theis Bryde's whale form has not yet been fully identified.~~ Two strandings from the southeastern U.S. Atlantic coast share the same genetic characteristics with those from the northern Gulf of Mexico (Rosel and Wilcox 2014), but it is unclear whether these are extralimital strays (Mead 1977) or whether they indicate the population extends from the northeastern Gulf of Mexico to the Atlantic coast of the southern U.S. (Rosel and Wilcox 2014). There have been no confirmed sightings of Rice~~Bryde~~'s whales along the U.S. east coast during NMFS cetacean surveys (Rosel *et al.* 2016; Rosel *et al.* 2021).

Historical whaling records from the 1800s suggest that Rice’s~~Bryde’s~~ whales may have been more common in the U.S. waters of the north central Gulf of Mexico and in the southern Gulf of Mexico in the Bay of Campeche (Reeves *et al.* 2011). How regularly they currently use U.S. waters of the western Gulf of Mexico is unknown. There has been only one genetically confirmed sighting of a ~~Gulf of Mexico~~ Rice’s~~Bryde’s~~ whale in this region, a whale observed during a 2017 NMFS vessel survey off Texas (Garrison *et al.* 2020; Rosel et al. 2021), despite substantial NMFS survey effort in the north central and western Gulf dating back to the early 1990s (e.g., Hansen et al. 1996; Mullin and Hoggard 2000; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). Rice’s whale calls were present on up to 16% of days per site during one year of acoustic recordings at three sites along the north-central and northwestern Gulf shelf break, indicating some whales persistently occur in waters beyond the core habitat (Soldevilla *et al.* in press). A compilation of available records of cetacean sightings, strandings, and captures in Mexican waters of the southern Gulf of Mexico identified no Rice’s~~Bryde’s~~ whales (Ortega-Ortiz 2002). Additional work to evaluate the~~ir~~ presence and abundance of this species in the western and southern Gulf of Mexico will further understanding of their distribution and the plausibility of additional demographically independent populations. ~~There are insufficient data to determine whether it is plausible the stock contains multiple demographically independent populations that should be separate stocks.~~

POPULATION SIZE

The best abundance estimate available for Rice’s~~Bryde’s~~ whales in the northern Gulf of Mexico is 51 (CV=0.50; Table 1). This estimate is from summer 2017 and summer/fall 2018 oceanic surveys covering waters from the 200-m isobath to the seaward extent of the U.S. EEZ (Garrison *et al.* 2020).

Earlier abundance estimates

Five point estimates of Rice’s~~Bryde’s~~ whale abundance have been made based on data from surveys during: 2003 (June−August), 2004 (April−June), 2009 (July−August), 2017 (July−August), and 2018 (August−October). Each of these surveys had a similar design and was conducted using the same vessel or a vessel with a similar observation platform. Surveys in 2003, 2004, and 2009 employed a single survey team while the 2017 and 2018 surveys employed two survey teams. In addition, the 2017 and 2018 surveys were conducted in “passing” mode rather than “closing” mode. Passing mode eliminates the problems of fragmented tracklines associated with using closing mode in areas with high densities of animals. When using the closing mode with the two-team method, both teams must be allowed the opportunity to see a mammal group and allow it to pass behind the ship before turning to close on it, making it difficult to reacquire the group and resulting in long periods spent chasing the group, with the increased potential for off-effort sightings. For passive acoustics, in closing mode the vessel often turns before the acoustic team is able to achieve a good localization. This is especially important for deep-diving species where visual surveys are less optimal for abundance estimates. However, passing mode can result in increased numbers of unidentified sightings and may have affected group size estimation for distant groups of dolphins and small whales. Comparisons of the survey results over the years 2003 through 2009 required adjustments for these differences, including apportioning unidentified species among identified taxa to address the first issue, applying the model for detection probability on the trackline from the summer 2017 survey to the abundance estimates from the 2003, 2004, and 2009 surveys, and examining relationships between sighting distance and estimated group size (Garrison *et al.* 2020). This resulted in revised abundance estimates of: 2003, N=0 (CV=NA); 2004, N=64 (CV=0.88); and 2009, N=100 (CV=1.03).

Recent surveys and abundance estimates

An abundance estimate for Rice’sBryde’s whales was generated from vessel surveys conducted in the northern Gulf of Mexico from the continental shelf edge (~200-m isobath) to the seaward extent of the U.S. EEZ (Garrison *et al.* 2020). One survey was conducted from 2 July to 25 August 2017 and consisted of 7,302 km of on-effort trackline, and the second survey was conducted from 11 August to 6 October 2018 and consisted of 6,473 km of on-effort trackline. The surveys were conducted in passing mode (e.g., Schwarz *et al.* 2010) while all prior surveys in the Gulf of Mexico have been conducted in closing mode. Both surveys used a double-platform data-collection procedure to allow estimation of the detection probability on the trackline using the independent observer approach assuming point independence (Laake and Borchers 2004). Due to the restricted habitat range of ~~Gulf of Mexico~~ Rice’s~~Bryde's~~ whales, survey effort was re-stratified to include only effort within their core habitat area (Figure 1; https://www.fisheries.noaa.gov/resource/map/gulf-mexico-brydes-whale-core-distribution-area-map-gis-data) including 941 km of effort in 2017 and 848 km of effort in 2018. In addition, there was an insufficient number of Rice’s~~Bryde's~~ whale sightings during these surveys to develop an appropriate detection probability function. Therefore, a detection function was derived based on 91 sightings of Rice’s~~Bryde's~~ whale groups observed during SEFSC large-vessel surveys between 2003 and 2019. The abundance estimates include unidentified large whales and baleen whales observed within the Rice's~~Bryde's~~ whale habitat. However, the estimate does not include the sighting of a confirmed Rice's~~Bryde's~~ whale in the western Gulf of Mexico in 2017. It is not possible to extrapolate estimated density beyond the core area since little is known about habitat use and distribution outside of this area. Estimates of abundance were derived using MCDS distance sampling methods that account for the effects of covariates (e.g., sea state, glare) on detection probability within the surveyed strip (Thomas *et al.* 2010) implemented in package mrds (version 2.21, Laake *et al.* 2020) in the R statistical programming language. The 2017 and 2018 estimates were N=84 (CV=0.92) and N=40 (CV=0.55), respectively. The inverse variance weighted mean calculation resulted in a best abundance estimate for Rice's~~Bryde's~~ whales in oceanic waters during 2017 and 2018 ~~was~~of 51 (CV=0.50; Table 1; Garrison *et al.* 2020). This estimate was not corrected for the probability of detection on the trackline because there was only one resighting and few sightings overall of Rice's~~Bryde's~~ whales during the two-team surveys.

Table 1. Best~~Most recent~~ abundance estimate (Nest) and coefficient of variation (CV) of Rice's~~Bryde's~~ whales in northern Gulf of Mexico oceanic waters (200 m to the offshore extent of the EEZ) based on the inverse variance weighted mean from summer 2017 and summer/fall 2018 vessel surveys.

Years	Area	Nest	CV Nest
2017, 2018	Gulf of Mexico	51	0.50

Minimum Population Estimate

The minimum population estimate (Nmin) is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Rice's~~Bryde's~~ whales is 51 (CV=0.50). The minimum population estimate for the northern Gulf of Mexico Rice's~~Bryde's~~ whale is 34 (Table 2).

Current Population Trend

Using revised abundance estimates for surveys conducted in 2003 (June−August), 2004 (April−June), and 2009 (July−August) (see above), and the 2017 (July−August) and 2018 (August−October) estimates, pairwise comparisons of the non-zero log-transformed means were conducted between years, and significant differences were assessed at alpha=0.10. P-values were adjusted for multiple comparisons. There were no significant differences in between survey years when whales were observed (Garrison *et al.* 2020).

However, the statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long intervals between surveys. For example, the power to detect a precipitous decline in abundance (i.e., 50% decrease in 15 years) with estimates of low precision (e.g., CV>0.30) remains below 80% (alpha=0.30) unless surveys are conducted on an annual basis (Taylor *et al.* 2007). In addition, because these surveys are restricted to U.S. waters, it is not possible to distinguish between changes in population size and Gulf-wide shifts in spatial distribution.

All verified Rice's~~Bryde's~~ whale sightings, with one exception, have occurred in a very restricted area of the northeastern Gulf (Figure 1) during surveys that uniformly sampled the entire oceanic northern Gulf. Because the population size is small, in order to effectively monitor trends in Rice's~~Bryde's~~ whale abundance in the future, other methods need to be used.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations likely do not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995). Between 1988 and 2018, there have been two documented strandings of calves (total length <700 cm) in the northern Gulf of Mexico (SEUS Historical Stranding Database unpublished data; NOAA National Marine Mammal Health and Stranding Response Database unpublished data).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997; Wade 1998). The minimum population size is 34. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.1 because the stock is listed as endangered. PBR for the northern Gulf of Mexico Rice's~~Bryde's~~ whale stock is 0.1 (Table 2; value is 0.068 before rounding (NMFS 2016)).

Table 2. Best and minimum abundance estimates for northern Gulf of Mexico Rice's~~Bryde's~~ whales with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

Nest	CV Nest	Nmin	Fr	Rmax	PBR
51	0.50	34	0.1	0.04	0.1

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual estimated fishery-related mortality and serious injury for the northern Gulf of Mexico Rice's~~Bryde's~~ whale stock during 2016–2020~~2014–2018~~ is unknown. There was no documented fishery-caused mortality or serious injury for this stock during 2016–2020~~2014–2018~~ (Table 3). Mean annual mortality and serious injury during 2016–2020~~2014–2018~~ due to other human-caused actions (the *Deepwater Horizon* oil spill, ingested plastic) was predicted to be 0.5 (Appendix VI). The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020~~2014–2018~~ was, therefore, 0.5. This is considered a minimum mortality estimate as some fisheries with which the stock could interact have limited observer coverage. In addition, the likelihood is low that a whale killed at sea due to a fishery interaction or vessel-strike will be recovered (Williams *et al.* 2011).

Table 3. Total annual estimated fishery-related mortality and serious injury for northern Gulf of Mexico Rice's~~Bryde's~~ whales.

Years	Source	Annual Avg.	CV
2016–2020~~2014–2018~~	U.S. fisheries using observer data	Unknown	-

Fisheries Information

There are three commercial fisheries that overlap geographically and potentially could interact with this stock in the Gulf of Mexico. These include the Category I Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fishery, and two Category III fisheries, the Southeastern U.S. Atlantic, Gulf of Mexico shark bottom longline/hook-and-line fishery and the Southeastern U.S. Atlantic, Gulf of Mexico, and Caribbean snapper-grouper and other reef fish bottom longline/hook-and-line fishery. See Appendix III for detailed fishery information. All three of these fisheries have observer programs, however observer coverage is limited for the two Category III fisheries.

Pelagic swordfish, tunas, and billfish are the targets of the large pelagics longline fishery operating in the northern Gulf of Mexico. During 2016–2020~~2014–2018~~ there were no observed mortalities or serious injuries to Rice's~~Bryde's~~ whales by this fishery (Garrison and Stokes ~~2016; 2017;~~ 2019; 2020a; 2020b; 2021; in prep). Percent observer coverage (percentage of sets observed) for this longline fishery for each year during 2016–2020~~2014–2018~~ was ~~18, 19,~~ 23, 13, ~~and~~ 20, 13, and 6.3, respectively. For the two category III bottom longline/hook-and-line fisheries, the target species are large and small coastal sharks and reef fishes such as snapper, grouper, and tilefish. There has been no reported fishery-related mortality or serious injury of a Rice's~~Bryde's~~ whale by either of these fisheries (e.g., Scott-Denton *et al.* 2011; Gulak *et al.* 2013; 2014; Enzenauer *et al.* 2015; 2016; Mathers *et al.* 2017; 2018; 2020a,b; 2021). Within the Gulf of Mexico, observer coverage for the snapper-grouper and other reef fish bottom longline fishery is ~1% or less annually, and for the shark bottom longline fishery coverage is 1–2% annually. Usually bottom longline gear is thought to pose less of a risk for cetaceans to become entangled than pelagic longline gear. However, if cetaceans forage along the seafloor, as is suspected for the Rice's~~Bryde's~~ whale (Soldevilla *et al.* 2017), then there is an opportunity for these whales to become entangled in the mainline as well as in the vertical buoy lines (Rosel *et al.* 2016).

Two other commercial fisheries that overlap to a small degree with the primary Rice's~~Bryde's~~ whale habitat in the northeastern Gulf of Mexico are the Category III Gulf of Mexico butterfish trawl fishery and Category II Southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl fishery (Rosel *et al.* 2016). No interactions with Rice's~~Bryde's~~ whales have been documented for either of these fisheries. There is no observer coverage for the butterfish trawl fishery. The shrimp trawl fishery has ~2% observer coverage annually.

Other Mortality

There was one~~were no~~ reported stranding~~s~~ of a Rice's~~Bryde's~~ whale~~s~~ in the Gulf of Mexico during 2016–2020~~2014–2018~~ (Henry et al. 2022; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021~~21 May 2019~~). One whale stranded in 2019, and there was evidence of human interaction in the form of a hard, sharp piece of ingested plastic. The plastic ingestion was believed to contribute to the stranding and ultimate death of the animal (Rosel *et al.* 2021).

Stranding data ~~probably~~ underestimate the extent of human and fishery-related mortality and serious injury because not all of the whales 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). In particular, oceanic stocks in the Gulf of Mexico are less likely to strand than nearshore coastal stocks or shelf stocks (Williams *et al.* 2011). 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 March 2010 and ending 31 July 2014 (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm, accessed 1 June 2016). It included cetaceans that stranded prior to the *Deepwater Horizon* (DWH) oil spill (see "Habitat Issues" below), during the spill, and after. Exposure to the DWH oil spill was determined to be the primary underlying cause of the elevated stranding numbers in the northern Gulf of Mexico after the spill (e.g., Schwacke *et al.* 2014; Venn-Watson *et al.* 2015; Colegrove *et al.* 2016; DWH NRDAT 2016; see Habitat Issues section). Two Rice's~~Bryde's~~ whale strandings in 2012 were considered to be part of this UME.

A population model was developed to estimate the injury and time to recovery for stocks affected by the DWH oil spill, taking into account long-term effects resulting from mortality, reproductive failure, reduced survival rates, and the proportion of the stock exposed to DWH oil (DWH MMIQT 2015). Based on the population model, it was projected that 1.4~~2.3~~ Rice's~~Bryde's~~ whales died during 2016–2020~~2014–2018~~ (see Appendix VI) due to elevated mortality associated with oil exposure and that the stock experienced a 22% maximum reduction in population size due to the oil spill (DWH MMIQT 2015). The DWH Marine Mammal Injury Quantification Team cautioned that the capability of Rice's~~Bryde's~~ whales to recover from the DWH oil spill is unknown because the population models do not account for stochastic processes and genetic effects (DWH MMIQT 2015), to which small populations are highly susceptible (Shaffer 1981; Rosel and Reeves 2000). The population model used to predict Rice's~~Bryde's~~ whale mortality due to the DWH event has a number of sources of uncertainty. Model parameters (e.g., survival rates, reproductive rates, and life-history parameters) were derived from literature sources for Rice's~~Bryde's~~ whales occupying waters outside of the Gulf of Mexico. In addition, proxy values for the effects of DWH oil exposure on both survival rates and reproductive success were applied based upon estimated values for common bottlenose dolphins in Barataria Bay. Finally, there was no estimation of uncertainty in model parameters or outputs.

It should be noted that vessel strikes also pose a threat to this stock (Soldevilla et al. 2017), although none were observed or documented during the 2016–2020 time period covered by this report. In 2009, a Rice's whale was found floating in the Port of Tampa, Tampa Bay, Florida. The whale had evidence of pre-mortem and post-mortem blunt trauma, and was determined to have been struck by a vessel, draped across the bow, and carried into port. In addition, Rosel et al. (2021) reported a 2019 sighting of a free-swimming Rice's whale with a spinal deformation consistent with a vessel strike at some point in the past.

All mortalities and serious injuries during 2016–2020 from known sources for Rice's whales are summarized in Table 4.

Table 4. Summary of the incidental mortality and serious injury of Rice's whales during 2016–2020 from all sources.

Mean Annual Mortality due to commercial fisheries (2016–2020, Table 3)	Unknown
Mean Annual Mortality due to the DWH oil spill (2016–2020, Appendix VI)	0.3

Mean Annual Mortality due to Other Human-Caused Sources (ingested plastic) (2016–2020)	0.2
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)	**0.5**

HABITAT ISSUES

The *DWH* MC252 drilling platform, located approximately 80 km southeast of the Mississippi River Delta in waters about 1,500 m deep, exploded on 20 April 2010. The rig sank, and over 87 days ~3.2 million barrels of oil were discharged from the wellhead until it was capped on 15 July 2010 (DWH NRDAT 2016). Shortly after the oil spill, the NRDA process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies were conducted to determine potential impacts of the spill on marine mammals. These studies estimated that 48% of Rice's~~Bryde's~~ whales in the Gulf were exposed to oil, that 22% (95% CI: 10–31) of females suffered from reproductive failure, and 18% (95% CI: 7–28) of the population suffered adverse health effects (DWH MMIQT 2015). A population model estimated the stock experienced a maximum 22% reduction in population size (see Other Mortality section above).

~~Vessel strikes also pose a threat to this stock (Soldevilla *et al.* 2017). In 2009, a Bryde's whale was found floating in the Port of Tampa, Tampa Bay, Florida. The whale had evidence of pre-mortem and post-mortem blunt trauma, and was determined to have been struck by a vessel, draped across the bow, and carried into port.~~

Anthropogenic sound in the world's oceans has been shown to affect marine mammals, with vessel traffic, seismic surveys, and active naval sonars being the main anthropogenic contributors to low- and mid-frequency noise in oceanic waters (e.g., Nowacek *et al.* 2015; Gomez *et al.* 2016; NMFS 2018). The long-term and population consequences of these impacts are less well-documented and likely vary by species and other factors. Impacts on marine mammal prey from sound are also possible (Carroll *et al.* 2017), but the duration and severity of any such prey effects on marine mammals are unknown.

New industries including aquaculture and wind energy development are actively being pursued in the Gulf of Mexico, which may have complex and adverse interactions with Rice's whales if development occurs within or near their habitat. The Gulf of Mexico has been chosen as one of the first areas for aquaculture development under the U.S. Presidential Executive Order 13921 (May 7, 2020) calling for the expansion of sustainable seafood production in the U.S. Potential impacts can occur at all stages of aquaculture development, operation, and decommissioning and can include attraction to farms or displacement from important habitats, resulting in changes to distribution, behaviors, or social structures (Clement 2013; Price *et al.* 2017; Heinrich *et al.* 2019). Physical interactions with gear (entanglement) or vessels can also result in injuries or mortalities (Price *et al.* 2017; Callier *et al.* 2018). For example, two Bryde's whale mortalities occurred in New Zealand due to entanglement in mussel farm spat lines (Baker *et al.* 2010). Possible indirect effects include noise or light pollution, habitat degradation, harmful algal blooms, or disease outbreaks (Clement 2013; Heinrich *et al.* 2019). Wind energy development has the potential to affect Rice's whales and/or their prey during pre-construction, construction, operation, and decommissioning through increased underwater sound and vibrations, vessel strikes, habitat alteration, chemical pollution, and entanglement (Rolland *et al.* 2012; Bailey *et al.* 2014; Taormina *et al.* 2018; Farr *et al.* 2021; Popper *et al.* 2022).

STATUS OF STOCK

The Rice's~~Bryde's~~ whale is listed as endangered under the Endangered Species Act, and therefore the northern Gulf of Mexico stock is considered strategic under the MMPA. The stock is very small and exhibits very low genetic diversity (Rosel and Wilcox 2014; Rosel *et al.* 2021), which places the stock at great risk of demographic stochasticity. The stock's restricted range also places it at risk of environmental stochasticity. In addition, the mean ~~modeled~~ annual human-caused mortality and serious injury ~~due to the DWH oil spill~~ exceeds PBR for this stock. The status of Rice's~~Bryde's~~ whales in the northern Gulf of Mexico, relative to optimum sustainable population~~OSP~~, is unknown. There was no statistically significant trend in population size for this stock.

REFERENCES CITED

Bailey, H., K.L. Brookes and P.M. Thompson. 2014. Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future. Aquat. Biosyst. 10:8. https://doi.org/10.1186/2046-9063-10-8

Baker, C.S., B.L. Chilvers, R. Constantine, S. DuFresne, R.H. Mattlin, A. van Helden and R. Hitchmough. 2010. Conservation status of New Zealand marine mammals (suborders Cetacea and Pinnipedia), 2009. N. Z. J. Mar. Freshwater Res. 44(2):101–115.

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.

Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. Fish. Bull. 112:1–23.

Callier, M.D., C.J. Byron, D.A. Bengtson, P.J. Cranford, S.F. Cross, U. Focken, H.M. Jansen, P. Kamermans, A. Kiessling, T. Landry, F. O'Beirn, E. Petersson, R.B. Rheault, O.. Strand., K. Sundell, T. Svasand, G.H. Wikfors and C.W. McKindsey. 2018. Attraction and repulsion of mobile wild organisms to finfish and shellfish aquaculture: a review. Rev. Aquac. 10:924–949.

Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Mar. Mamm. Sci. 32(1):349–362.

Carroll, A.G., R. Przeslawski, A. Duncan, M. Gunning, B. Bruce. 2017. A critical review of the potential impacts of marine seismic surveys on fish & invertebrates. Mar. Pollut. Bull. 114:9–24.

Clement, D. 2013. Literature review of ecological effects of aquaculture: effects on marine mammals. Report prepared for the New Zealand Ministry for Primary Industries by Cawthron Institute and NIWA: Nelson and Christchurch, NZ. https://www.mpi.govt.nz/dmsdocument/3752-Literature-Review-of-Ecological-Effects-of-Aquaculture-Chapter-4-Effects-on-Marine-Mammals

Colegrove, K.M., S. Venn-Watson, J. Litz, M.J. Kinsel, K.A. Terio, E. Fougeres, R. Ewing, D.A. Pabst, W.A. McLellan, S. Raverty, J. Saliki, S. Fire, G. Rappucci, S. Bowen-Stevens, L. Noble, A. Costidis, M. Barbieri, C. Field, S. Smith, R.H. Carmichael, C. Chevis, W. Hatchett, D. Shannon, M. Tumlin, G. Lovewell, W. McFee and T.K. Rowles. 2016. Fetal distress and in utero pneumonia in perinatal dolphins during the Northern Gulf of Mexico unusual mortality event. Dis. Aquat. Org. 119(1):1–16.

DWH MMIQT. 2015. Models and analyses for the quantification of injury to Gulf of Mexico cetaceans from the *Deepwater Horizon* Oil Spill, MM_TR.01_Schwacke_Quantification.of.Injury.to.GOM.Cetaceans. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, Florida 33140. PRBD Contribution #: PRBD-2020-02.

DWH NRDAT (*Deepwater Horizon* Natural Resource Damage Assessment Trustees). 2016. *Deepwater Horizon* oil spill: Final programmatic damage assessment and restoration plan and final programmatic environmental impact statement. Available from: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

Enzenauer, M.P., B.M. Deacy and J.K. Carlson. 2015. Characterization of the shark bottom longline fishery, 2014. NOAA Tech. Memo. NMFS-SEFSC-677. 24 pp.

Enzenauer, M.P., B.M. Deacy and J.K. Carlson. 2016. Characterization of the shark bottom longline fishery, 2015. NOAA Tech. Memo. NMFS-SEFSC-689. 23 pp.

~~Garrison, L.P. and L. Stokes. 2016. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2014. NOAA Tech. Memo. NMFS-SEFSC-696. 62 pp.~~

~~Garrison, L.P. and L. Stokes. 2017. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2015. NOAA Tech. Memo. NMFS-SEFSC-709. 61 pp.~~

Farr, H., B. Ruttenberg, R.K. Walter, Y. Wang and C. White. Potential environmental effects of deepwater floating offshore wind energy facilities. Ocean Coast. Manage. 207:105611.

Garrison, L.P. and L. Stokes. 2019. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2016. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, Florida 33140. PRBD Contribution # PRBD-2019-01. 62 pp.

Garrison, L.P. and L. Stokes. 2020a. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2017. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, Florida 33140. PRD Contribution # PRD-2020-05. 61 pp.

Garrison, L.P. and L. Stokes. 2020b. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2018. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, Florida 33140. PRD Contribution # PRD-2020-08. 56 pp.

Garrison, L.P. and L. Stokes. 2021. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2019. NOAA Tech. Memo. NMFS-SEFSC-750. 59 pp.

Garrison, L.P. and L. Stokes. in prep. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2020. NOAA Tech. Memo. NMFS-SEFSC-XXX. XX pp.

Garrison, L.P., J. Ortega-Ortiz and G. Rappucci. 2020. Abundance of marine mammals in the waters of the U.S. Gulf of Mexico in the summer of 2017 and 2018. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, Florida 33140. PRBD Contribution # PRBD-2020-07. 55 pp. Available from: https://repository.library.noaa.gov/view/noaa/26505

Gomez, C., J.W. Lawson, A.J. Wright, A.D. Buren, D. Tollit and V. Lesage. 2016. A systematic review on the behavioural responses of wild marine mammals to noise: The disparity between science and policy. Can. J. Zool. 94:801–819.

Gulak, S.J.B., M.P. Enzenauer and J.K. Carlson. 2013. Characterization of the shark and reef fish bottom longline fisheries: 2012. NOAA Tech. Memo. NMFS-SEFSC-652. 42 pp.

Gulak, S.J.B., M.P. Enzenauer and J.K. Carlson. 2014. Characterization of the shark and reef fish bottom longline fisheries: 2013. NOAA Tech. Memo. NMFS-SEFSC-658. 22 pp.

Hansen, L.J., K.D. Mullin, T.A. Jefferson and G.P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Heinrich, S., T. Genov, M. Fuentes-Riquelme and P.S. Hammond. 2019. Fine-scale habitat partitioning of Chilean and Peale's dolphins and their overlap with aquaculture. Aquatic Conserv: Mar. Freshw. Ecosyst. 29(S1): 212–226.

Henry, A.G., M. Garron, D. Morin, A. Smith, A. Reid, W. Ledwell and T.V.N. Cole. 2022. Mortality and serious injury determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2015–2019. NOAA Tech Memo. NMFS-NE-280. 65 pp. https://repository.library.noaa.gov/view/noaa/38941~~Kato, H. and W.F. Perrin. 2008. Bryde's whales *Balaenoptera edeni/brydei*. Pages 158–163 *In:* W. F. Perrin, B. Würsig and J. G.M. Thewissen (eds.) Encyclopedia of Marine Mammals, Second Edition. Academic Press, San Diego, California. 1352 pp.~~

Laake, J.L. and D.L. Borchers. 2004. Methods for incomplete detection at distance zero, In: Advanced distance sampling, edited by S. T. Buckland, D. R. Andersen, K. P. Burnham, J. L. Laake, and L. Thomas, pp. 108–189, Oxford University Press, New York.

Laake, J., D. Borchers, L. Thomas, D. Miller and J. Bishop. 2020. Package 'mrds': Mark-recapture distance sampling. Version 2.2.3. Available from: http://github.com/DistanceDevelopment/mrds/~~Leatherwood, S. and R.R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, California. 302 pp.~~

Litz, J.A., M.A. Baran, S.R. Bowen-Stevens, R.H. Carmichael, K.M. Colegrove, L.P. Garrison, S.E. Fire, E.M. Fougeres, R. Hardy, S. Holmes, W. Jones, B.E. Mase-Guthrie, D.K. Odell, P.E. Rosel, J.T. Saliki, D.K. Shannon, S.F. Shippee, S.M. Smith, E.M. Stratton, M.C. Tumlin, H.R. Whitehead, G.A.J. Worthy and T.K. Rowles. 2014. Review of historical unusual mortality events (UMEs) in the Gulf of Mexico (1990–2009): Providing context for the complex and long-lasting northern Gulf of Mexico cetacean UME. Dis. Aquat. Organ. 112:161–~~-~~175.

Mathers, A.N., B.M. Deacy, M.P. Enzenauer and J.K. Carlson. 2017. Characterization of the shark bottom longline fishery, 2016. NOAA Tech. Memo. NMFS-SEFSC-714. 23 pp.

Mathers, A.N., B.M. Deacy, H.E. Moncrief-Cox and J.K. Carlson. 2018. Characterization of the shark bottom longline fishery, 2017. NOAA Tech. Memo. NMFS-SEFSC-727. 21 pp.

Mathers, A.N., B.M. Deacy, H.E. Moncrief-Cox and J.K. Carlson. 2020a. Characterization of the shark bottom longline fishery: 2018. NOAA Tech. Memo. NMFS-SEFSC-744. 26 pp.

Mathers, A.N., B.M. Deacy, H.E. Moncrief-Cox and J.K. Carlson. 2020b. Catch and bycatch in U.S. Southeast gillnet fisheries, 2018. NOAA Tech. Memo. NMFS-SEFSC-743. 15 pp.

Mathers, A.N., B.M. Deacy, H.E. Moncrief-Cox and J.K. Carlson. 2021. Characterization of the shark bottom longline fishery: 2019. NOAA Tech. Memo. NMFS-SEFSC-XXX. XX pp.

Maze-Foley, K. and K.D. Mullin. 2006. Cetaceans of the oceanic northern Gulf of Mexico: Distributions, group sizes and interspecific associations. J. Cetacean Res. Manage. 8(2):203–213.

Mead, J.G. 1977. Records of Sei and Bryde's whales from the Atlantic Coast of the United States, the Gulf of Mexico, and the Caribbean. Rep. Int. Whal. Comm. (Special Issue) 1:113–116.

Mullin, K.D. 2007. Abundance of cetaceans in the oceanic northern Gulf of Mexico from 2003 and 2004 ship surveys. NOAA Southeast Fisheries Science Center, 3209 Frederic Street, Pascagoula, MS 39567. PRBD Contribution #PRBD-2016-03. 27 pp.

Mullin, K.D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. ~~pp.~~Pages 111–~~–~~172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Mullin, K.D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4):787–807.

NMFS [National Marine Fisheries Service]. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016. http://www.nmfs.noaa.gov/op/pds/index.html

NMFS [National Marine Fisheries Service]. 2018. 2018 Revisions to: Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (Version 2.0): Underwater thresholds for onset of permanent and temporary threshold shifts. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-OPR-59. 167 pp. ~~Available from:~~ https://repository.library.noaa.gov/view/noaa/17892

Nowacek, D.P., C.W. Clark, D. Mann, P.J.O. Miller, H.C. Rosenbaum, J.S. Golden, M. Jasny, J. Kraska and B.L. Southall. 2015. Marine seismic surveys and ocean noise: time for coordinated and prudent planning. Front. Ecol. Environ. 13:378–386.

Ortega-Ortiz, J. 2002. Multiscale analysis of cetacean distribution in the Gulf of Mexico. Ph.D. dissertation. Texas A&M University, College Station. 170 pp.

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: modelling the drift of cetacean carcasses. Ecol. Indicators 18:278–290.

Popper, A.N., L. Hice-Dunton, E. Jenkins, D.M. Higgs, J. Krebs, A. Mooney, A. Rice, L. Roberts, F. Thomsen, K. Vigness-Raposa, D. Zeddies and K.A. Williams. 2022. J. Acoust. Soc. Am. 151:205–215.

Price, C.S., J.A. Morris, Jr., E. Keane, D. Morin, C. Vaccaro and D. Bean. 2017. Protected species and marine aquaculture interactions. NOAA Tech. Memo. NOS NCCOS 211. 85 pp. https://repository.library.noaa.gov/view/noaa/16942

Reeves, R.R., J.N. Lund, T.D. Smith and E.A. Josephson. 2011. Insights from whaling logbooks on whales, dolphins, and whaling in the Gulf of Mexico. G. Mex. Sci. 29(1):41–67.

Rice, A.N., J.T. Tielens, K.J. Palmer, A. Muirhead and C.W. Clark. 2014. Potential Bryde's whale calls (*Balaenoptera edeni*) recorded in the northern Gulf of Mexico. J. Acoust. Soc. Amer. 135:3066–3076.

Rolland, R.M., S.E. Parks, K.E. Hunt, M. Castellote, P. J. Corkeron, D.P. Nowacek, S.K. Wasser and S.D. Kraus. 2012. Evidence that ship noise increases stress in right whales. Proc. R. Soc. B 279:2363–2368.

Rosel, P.E. and R.R. Reeves. 2000. Genetic and demographic considerations for the conservation of Asian river cetaceans. pp. 144–152. *In:* R.R. Reeves, B.D. Smith and T. Kasuya (eds) Biology and conservation of freshwater cetaceans in Asia. IUCN, Gland, Switzerland and Cambridge, UK.

Rosel, P.E. and L.A. Wilcox. 2014. Genetic evidence reveals a unique lineage of Bryde's whales in the northern Gulf of Mexico. Endang. Species Res. 25:19–34.

Rosel, P.E., P. Corkeron, L. Engleby, D. Epperson, K.D. Mullin, M.S. Soldevilla and B.L. Taylor. 2016. Status review of Bryde's whales (*Balaenoptera edeni*) in the Gulf of Mexico under the Endangered Species Act. NOAA Tech. Memo. NMFS-SEFSC-692. 133 pp.

Rosel, P.E., L.A. Wilcox, T.K. Yamada and K.D. Mullin. 2021. A new species of baleen whale (*Balaenoptera*) from the Gulf of Mexico, with a review of its geographic distribution. Mar. Mamm. Sci. 37:577–610.

Schwacke, L.H., C.R. Smith, F.I. Townsend, R.S. Wells, L.B. Hart, B.C. Balmer, T.K. Collier, S. De Guise, M.M. Fry, L.J. Guillette, S.V. Lamb, S.M. Lane, W.E. McFee, N.J. Place, M.C. Tumlin, G.M. Ylitalo, E.S. Zolman and T.K. Rowles. 2014. Health of bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana following the *Deepwater Horizon* oil spill. Environ. Sci. Technol. 48(1):93–103.

Schwarz, L.K., T. Gerrodette and F.I. Archer. 2010. Comparison of closing and passing mode from a line-transect survey of delphinids in the eastern Tropical Pacific Ocean. J. Cetacean Res. Manage. 11(3):253–265.

Scott-Denton, E., P.F. Cryer, J.P. Gocke, M.R. Harrelson, D.L. Kinsella, J.R. Pulver, R.C. Smith and J.A. Williams. 2011. Descriptions of the U.S. Gulf of Mexico reef fish bottom longline and vertical line fisheries based on observer data. Mar. Fish. Rev. 73(2):1–26.

Shaffer, M.L. 1981. Minimum population sizes for species conservation. BioScience 31:131–134.

Širović, A., H.R. Bassett, S.C. Johnson, S.M. Wiggins and J.A. Hildebrand. 2014. Bryde's whale calls recorded in the Gulf of Mexico. Mar. Mamm. Sci. 30(1):399–409.

Soldevilla, M.S., A. J. Debich, L. P. Garrison, J. A. Hildebrand and S. M. Wiggins. 2022. Rice's whales in the northwestern Gulf of Mexico: Call variation and occurrence beyond the known core habitat. Endanger. Species Res. 48:155–174.

Soldevilla, M.S., J.A. Hildebrand, K.E. Frasier, L.A. Dias, A. Martinez, K.D. Mullin, P.E. Rosel and L.P. Garrison. 2017. Spatial distribution and dive behavior of Gulf of Mexico Bryde's whales: Potential risk of vessel strikes and fisheries interactions. Endanger. Species Res. 32:533–550.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy and A. Carlier. 2018. A review of potential impacts of submarine power cables on the marine environment: Knowledge gaps, recommendations and future directions. Renew. Sust. Energ. Rev. 96:380–391.

Taylor, B.L., M. Martinez, T. Gerrodette, J. Barlow and Y.N. Hrovat. 2007. Lessons from monitoring trends in abundance in marine mammals. Mar. Mamm. Sci. 23:157–175.

Thomas, L., S.T. Buckland, E.A. Rexstad, J.L. Laake, S. Streindberg, S.L. Hedley, J.R.B. Bishop, T.A. Marques and K.P. Burnham. 2010. Distance software: Design and analysis of distance sampling surveys for estimating population size. J. Appl. Ecol. 47(1):5–14.

Venn-Watson, S., K.M. Colegrove, J. Litz, M. Kinsel, K. Terio, J. Saliki, S. Fire, R. Carmichael, C. Chevis, W. Hatchett, J. Pitchford, M. Tumlin, C. Field, S. Smith, R. Ewing, D. Fauquier, G. Lovewell, H. Whitehead, D. Rotstein, W. McFee, E. Fougeres and T. Rowles. 2015. Adrenal gland and lung lesions in Gulf of Mexico common bottlenose dolphins (*Tursiops truncatus*) found dead following the *Deepwater Horizon* Oil Spill. PLoS ONE 10(5):e0126538.

Wade, P.R. 1998. Calculating limits to the allowable human-caused mortality of cetaceans and pinnipeds. Mar. Mamm. Sci. 14(1):1–37.

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

Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Mar. Mamm. Sci. 31(1):355–368.

Williams, R., S. Gero, L. Bejder, J. Calambokidis, S.D. Kraus, D. Lusseau, A.J. Read and J. Robbins. 2011. Underestimating the damage: Interpreting cetacean carcass recoveries in the context of the *Deepwater Horizon*/BP incident. Conserv. Lett. 4:228–233.