Northeast Fisheries Science Center Technical Memorandum 336

U.S. Atlantic and Gulf of America Marine Mammal Stock Assessments 2024

US DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

July 2025

Northeast Fisheries Science Center Technical Memorandum 336

U.S. Atlantic and Gulf of America Marine Mammal Stock Assessments 2024

Sean A. Hayes[1], Elizabeth Josephson[1], Katherine Maze-Foley[2], Patricia E. Rosel[3], and Jessica McCordic[1], Editors

with contributions from (listed alphabetically):

Matthew Bowers[4], Amy Brossard[2], Samuel Chavez-Rosales[1], Timothy V.N. Cole[1], Annamaria I. DeAngelis[1], Lance P. Garrison[4], Joshua Hatch[1], Allison Henry[1], Daniel Linden[1], Jenny Litz[4], Marjorie C. Lyssikatos[1], Abigail Machernis[5], Keith D. Mullin[6], Kimberly Murray[1], Christopher Orphanides[1], Richard M. Pace[1], Debra L. Palka[1], Jessica Powell[7], Kristin Precoda[1], Melissa Soldevilla[4], and Frederick W. Wenzel[1]

[1] *National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543*

[2] *CIMAS, University of Miami, in support of National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, FL33149*

[3] *National Marine Fisheries Service, 646 Cajundome Blvd. Suite 234, Lafayette, LA70506*

[4] *National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, FL33149*

[5] *ERT in support of National Marine Fisheries Service, 263 13th Ave. South, St. Petersburg, FL33701*

[6] *National Marine Fisheries Service, 3209 Frederic St., Pascagoula, MS 39567*

[7] *National Marine Fisheries Service, 263 13th Ave. South, St. Petersburg, FL33701*

US DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

July 2025

ACKNOWLEDGMENTS

The authors wish to acknowledge the advice, comments and valuable contributions provided by the Northeast Fisheries Science Center Fisheries Sampling Branch; members of the Northeast and Southeast Marine Mammal Stranding Networks; Mendy Garron, Amanda Johnson, David Gouveia, Allison Rosner, Cheryl Cross, Elizabeth Stratton, and Ainsley Smith of the Northeast Regional Office; Laura Dias, Ruth Ewing, Kendall Falana, Daniel Foster, Michael Hendon, Emma Martinez, Blair Mase, Alyssa Mathers, Gina Rappucci, Elizabeth Scott-Denton, and Carrie Sinclair of the Southeast Fisheries Science Center; Hailey Foglio, Jarita Davis, Michael Simpkins, and Jon Hare of the Northeast Fisheries Science Center; Laura Engleby and Kara Shervanick of the Southeast Regional Office; Zachary Schakner of the Office of Science and Technology; Eric Patterson and Courtney Smith of the Office of Protected Resources; Brian Balmer, Todd Speakman, and Eric Zolman of the National Marine Mammal Foundation; Wayne McFee of the National Ocean Service; Wendy Noke of Hubbs-SeaWorld Research Institute; David Bauman of the U.S. Army Corps of Engineers; Lori Schwacke of the Marine Mammal Commission; and Robert Bonde, Yong Chen, Francine Kershaw, Jack Lawson, Erin Meyer-Gutbrod, Richard Merrick, Geneviève Nesslage, Kathryn Ono, James 'Buddy' Powell, Arturo Serano-Solis, Sarah Sharp, Ana Širović, Erin Summers, Len Thomas, Lesley Thorne, and Randall Wells of the Atlantic Scientific Review Group. We also thank the Marine Mammal Commission and Center for Biological Diversity for their constructive comments and advice.

SPECIAL ACKNOWLEDGMENT

NMFS and the Atlantic Scientific Review Group (ASRG) members would like to especially thank and honor a recently departed friend, colleague, and member of the ASRG, James 'Buddy' Powell. Buddy volunteered his service as an ASRG member for many years. On a professional level, his commitment to right whale surveys in the Southeast has been a huge part of its success for decades, which has had incalculable benefits for the species. His devotion to manatee research made it possible for both the animals to have better lives as well as for many people to have the opportunity to experience and appreciate them. Buddy's life-long dedication to marine mammal conservation made an incredible impact across the world. On a more personal level, his quiet wisdom, patience and gentle smile always made everyone feel more at ease. The friendship and respect he fostered among the ASRG and NMFS staff will always serve as a model for us. We are grateful for all the lives Buddy touched, both human and animal. We believe the world is a much better place because Buddy was a part of it.

EXECUTIVE SUMMARY

Under the 1994 amendments of the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) were required to generate stock assessment reports (SARs) for all marine mammal stocks in waters within the U.S. Exclusive Economic Zone (EEZ). The first reports for the Atlantic (includes the Gulf of America) were published in July 1995 (Blaylock *et al.* 1995). The MMPA requires NMFS and USFWS to review these reports annually for strategic stocks of marine mammals and at least every three years for stocks determined to be non-strategic. Included in this report as appendices are: a summary of serious injury/mortality estimates of marine mammals in observed U.S. fisheries (Appendix I), a summary of NMFS records of large whale human-caused serious injury and mortality (Appendix II), detailed fisheries information (Appendix III), summary tables of abundance estimates generated over recent years and the surveys from which they are derived (Appendix IV), a summary of observed fisheries bycatch (Appendix V), and estimates of human-caused mortality resulting from the *Deepwater Horizon* oil spill (Appendix VI).

Table 1 contains a summary, by stock, of the information included in the stock assessments, and also indicates those that have been revised since the 2023 publication. The 2024 revisions consist primarily of updated abundance estimates and/or revised human-caused mortality and serious injury (M/SI) estimates. A total of 11 Atlantic and Gulf of America stock assessment reports were updated for 2024. This year, the NEFSC revised 7 stock assessment reports, and the SEFSC revised 4 reports. The revisions consist primarily of updated abundance estimates and revised human-caused mortality and serious injury (M/SI) estimates. For the Biscayne Bay Stock of common bottlenose dolphin, the first capture-mark-recapture abundance estimate for this stock is reported.

This report was prepared by staff of the Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). NMFS staff presented the reports at the February 2024 meeting of the Atlantic Scientific Review Group (ASRG), and subsequent revisions were based on their contributions and constructive criticism. This is a working document and individual stock assessment reports will be updated as new information becomes available and as changes to marine mammal stocks and fisheries occur. The authors solicit any new information or comments which would improve future stock assessment reports.

TABLE OF CONTENTS

INTRODUCTION....6

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. 7

CUVIER'S BEAKED WHALE 21

BLAINVILLE'S BEAKED WHALE....29

GERVAIS' BEAKED WHALE 36

SOWERBY'S BEAKED WHALE....44

TRUE'S BEAKED WHALE....52

TAMANEND'S BOTTLENOSE DOLPHIN (*Tursiops erebennus*): Western North Atlantic South Carolina/Georgia Coastal Stock 60

TAMANEND'S BOTTLENOSE DOLPHIN (*Tursiops erebennus*): Western North Atlantic Northern Florida Coastal Stock..72

TAMANEND'S BOTTLENOSE DOLPHIN (*Tursiops erebennus*): Western North Atlantic Central Florida Coastal Stock....83

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus*) Biscayne Bay Stock…….....……...…...94

HARBOR PORPOISE……104

GRAY SEAL……..115

Appendix I: Estimated mortality and serious injury (M/SI) of Western North Atlantic marine mammals listed by U.S. observed fisheries. Marine mammal species with zero (0) observed M/SI are not shown in this table....127

Appendix II: Summary of the confirmed observed human-caused mortality and serious injury (M/SI) events involving baleen whale stocks along the Gulf of America Coast, U.S. East Coast, and adjacent Canadian Maritimes, 2018–2022, with number of events attributed to entanglements or vessel collisions by year....129

Appendix III: Fishery Descriptions - List of Figures……...130

Appendix IV: Surveys……...…….....……..172

Appendix V: Fishery Bycatch Summaries....193

Appendix VI: Estimates of Human-caused Mortality Resulting from the Deepwater Horizon Oil Spill…….....…...222

INTRODUCTION

Section 117 of the 1994 amendments to the Marine Mammal Protection Act (MMPA) requires that an annual stock assessment report (SAR) for each stock of marine mammals that occurs in waters under USA jurisdiction, be prepared by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), in consultation with regional Scientific Review Groups (SRGs). The SRGs are a broad representation of marine mammal and fishery scientists and members of the commercial fishing industry mandated to review the marine mammal stock assessments and provide advice to the NOAA Assistant Administrator for Fisheries. The reports are then made available on the *Federal Register* for public review and comment before final publication.

The MMPA requires that each SAR contain several items, including: (1) a description of the stock, including its geographic range; (2) a minimum population estimate, a maximum net productivity rate, and a description of current population trend, including a description of the information upon which these are based; (3) an estimate of the annual human-caused mortality and serious injury of the stock, and, for a strategic stock, other factors that may be causing a decline or impeding recovery of the stock, including effects on marine mammal habitat and prey; (4) a description of the commercial fisheries that interact with the stock, including the estimated number of vessels actively participating in the fishery and the level of incidental mortality and serious injury of the stock by each fishery on an annual basis; (5) a statement categorizing the stock as strategic or not, and why; and (6) an estimate of the potential biological removal (PBR) level for the stock, describing the information used in the calculation. The MMPA also requires that SARs be reviewed annually for stocks which are specified as strategic stocks, or for which significant new information is available, and once every three years for non-strategic stocks.

Following enactment of the 1994 amendments, the NMFS and USFWS held a series of workshops to develop guidelines for preparing the SARs. The first set of stock assessments for the Atlantic Coast (including the Gulf of America) were published in July 1995 in the *NOAA Technical Memorandum* series (Blaylock *et al.* 1995). In April 1996, NMFS held a workshop to review proposed additions and revisions to the guidelines for preparing SARs (Wade and Angliss 1997). Guidelines developed at the workshop were followed in preparing the 1996 through 2016 SARs. In 1997 and 2004 SARs were not produced. Guidelines for preparing SARs were revised again in 2016 based largely on recommendations of the 2011 GAMMS III workshop (NMFS 2016). The revised guidelines were followed in preparing the 2017 to 2022 SARs. Guidelines were scheduled for further review in 2021, and revised guidelines (GAMMS IV) were published in early 2023 (NMFS 2023). NMFS began partial implementation of the revised guidelines for the 2023 SARs.

In this document, major revisions and updating of the SARs were completed for stocks for which significant new information was available. These are identified by the July 2025 date-stamp at the top right corner at the beginning of each report.

REFERENCES

Blaylock, R.A., J.W. Hain, L.J. Hansen, D.L. Palka and G.T. Waring. 1995. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments. NOAA Tech. Memo. NMFS-SEFSC-363, 211pp.

NMFS. 2016. Guidelines for preparing stock assessment reports pursuant to the 1994 amendments to the MMPA. NMFS Instruction 02-204-01, February 22, 2016.

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.

NMFS. 2023. Guidelines for preparing stock assessment reports pursuant to the Marine Mammal Protection Act. Protected Resources Policy Directive 02-204-01. https://www.fisheries.noaa.gov/s3/2023-05/02-204-01-Final-GAMMS-IV-Revisions-clean-1-kdr.pdf

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 and serious injury (M/SI) and annual fisheries M/SI are mean annual figures for the period 2018–2022. 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	N	372	0	367	0.04	0.1	0.73	14.8	10.8	Y	2023	2022		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	N	6,802	0.24	5,573	0.04	0.1	11	2.05	1.45	Y	2023	2021		NEC
4	Sei whale	Nova Scotia	N	6,292	1.02	3,098	0.04	0.1	6.2	0.6	0.4	Y	2023	2021		NEC
5	Minke whale	Canadian East Coast	N	21,968	0.31	17,002	0.04	0.5	170	9.4	8.6	N	2023	2021		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	5,895	0.29	4,639	0.04	0.1	9.28	0.2	0	Y	2023	2021		NEC
8	Dwarf sperm whale	Western North Atlantic	N	9,474	0.36	7,080	0.04	0.4	57	unk	0.8	N	2023	2021	Estimates for *Kogia spp.*	SEC
9	Pygmy sperm whale	Western North Atlantic	N	9,474	0.36	7,080	0.04	0.4	57	unk	0.8	N	2023	2021	Estimates for *Kogia spp.*	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	2023	2021		SEC
12	False killer whale	Western North Atlantic	N	1,298	0.72	755	0.04	0.5	7.6	0	0	N	2023	2021		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.
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	Y	4,260	0.24	3,817	0.04	0.5	38	0.2	0	N	2023	2021		NEC
15	Blainville's beaked whale	Western North Atlantic	Y	2,936	0.26	2,374	0.04	0.5	24	0	0	N	2023	2021		NEC
16	Gervais beaked whale	Western North Atlantic	Y	8,595	0.24	7,022	0.04	0.5	70	0	0	N	2023	2021		NEC
17	Sowerby's beaked whale	Western North Atlantic	Y	492	0.50	340	0.04	0.5	3.4	0	0	N	2023	2021		NEC
18	True's beaked whale	Western North Atlantic	Y	4,480	0.34	3, 391	0.04	0.5	34	0	0	N	2023	2021		NEC
19	Melon-headed whale	Western North Atlantic	N	unk	unk	unk	0.04	0.5	unk	0	0	N	2023	2021		SEC
20	Risso's dolphin	Western North Atlantic	Y	44,067	0.19	30,662	0.04	0.5	307	18	18 (0.09)	N	2021	2021		NEC
21	Pilot whale, long-finned	Western North Atlantic	N	39,215	0.30	30,627	0.04	0.5	306	5.7	5.5 (0.29)	N	2023	2021		NEC
22	Pilot whale, short-finned	Western North Atlantic	N	18,726	0.33	14,292	0.04	0.5	143	218	218 (0.19)	Y	2023	2021		SEC
23	Atlantic white-sided dolphin	Western North Atlantic	N	93,233	0.71	54,443	0.04	0.5	544	28	28(0.19)	N	2023	2021		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
25	Common dolphin	Western North Atlantic	N	93,100	0.56	59,897	0.04	0.5	599	414	414 (0.10)	N	2023	2021		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.
26	Atlantic spotted dolphin	Western North Atlantic	N	31,506	0.28	25,042	0.04	0.5	250	0	0	N	2023	2021		SEC
27	Pantropical spotted dolphin	Western North Atlantic	N	2,757	0.50	1,856	0.04	0.5	19	0	0	N	2023	2021		SEC
28	Striped dolphin	Western North Atlantic	N	48,274	0.29	38,040	0.04	0.5	380	0	0	N	2023	2021		NEC
29	Fraser's dolphin	Western North Atlantic	N	unk	unk	unk	0.04	0.5	unk	0	0	N	2023	2021		SEC
30	Rough-toothed dolphin	Western North Atlantic	N	unk	unk	unk	0.04	0.5	undet	0	0	N	2023	2021		SEC
31	Clymene dolphin	Western North Atlantic	N	21,778	0.72	12,622	0.04	0.5	126	0	0	N	2023	2021		SEC
32	Spinner dolphin	Western North Atlantic	N	3,181	0.65	1,930	0.04	0.5	19	0	0	N	2023	2021		SEC
33	Common bottlenose dolphin	Western North Atlantic, Offshore	N	64,587	0.24	52,801	0.04	0.48	507	28	28 (0.43)	N	2023	2021	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	Y	9,121	0.28	7,261	0.04	0.5	73	0.2–0.6	0.2–0.6	Y	2017	2021		SEC
37	Common bottlenose dolphin	Western North Atlantic, Northern Florida Coastal	Y	3,619	0.35	2,711	0.04	0.5	27	0.2	0	Y	2017	2021		SEC
38	Common bottlenose dolphin	Western North Atlantic, Central Florida Coastal	Y	2,541	0.46	1,760	0.04	0.5	18	0.2	0	Y	2017	2021		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	2013		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	2006		SEC
41	Common bottlenose dolphin	Northern South Carolina Estuarine System	N	453	0.28	359	0.04	0.5	3.6	0.5	0.3	N	2022	2016		SEC
42	Common bottlenose dolphin	Charleston Estuarine System	N	unk	unk	unk	0.04	0.5	undet	2.2	1.8	Y	2022	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	unk	unk	unk	0.04	0.5	unk	1.5	1.3	Y	2022	n/a		SEC
44	Common bottlenose dolphin	Central Georgia Estuarine System	N	unk	unk	unk	0.04	0.5	undet	0.4	0.2	Y	2022	2008, 2009		SEC
45	Common bottlenose dolphin	Southern Georgia Estuarine System	N	unk	unk	unk	0.04	0.5	undet	0.1	0.1	Y	2022	2008, 2009		SEC
46	Common bottlenose dolphin	Jacksonville Estuarine System	N	unk	unk	unk	0.04	0.5	unk	2.0	2.0	Y	2022	n/a		SEC
47	Common bottlenose dolphin	Indian River Lagoon Estuarine System	N	1,032	0.03	1,004	0.04	0.5	10	5.7	3.0	Y	2022	2016, 2017		SEC
48	Common bottlenose dolphin	Biscayne Bay	Y	241	0.04	233	0.04	0.5	2.3	1.0	0.6	Y	2022	2019		SEC
49	Harbor porpoise	Gulf of Maine, Bay of Fundy	Y	85,765	0.53	56,420	0.046	0.5	649	142.4	142(0.11)	N	2023	2021		NEC
50	Harbor seal	Western North Atlantic	N	61,336	0.08	57,637	0.12	0.5	1,729	339	334 (0.09)	N	2021	2018		NEC
51	Gray seal	Western North Atlantic	Y	27,911	0.20	23,624	0.128	0.5	756	4,491	1,275 (0.08)	N	2023	2021		NEC
52	Harp seal	Western North Atlantic	N	7.6M	unk	7.1M	0.12	1.0	426,000	178,573	86 (0.16)	N	2021	2019		NEC
53	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

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.
54	Sperm whale	Gulf of America	N	1,180	0.22	983	0.04	0.1	2.0	9.6	0.2 (1.0)	Y	2020	2017, 2018		SEC
55	Rice's whale	Gulf of America	N	51	0.5	34	0.04	0.1	0.1	0.5	0	Y	2022	2017, 2018	Total M/SI is a minimum estimate and does not include Fisheries M/SI.	SEC
56	Cuvier's beaked whale	Gulf of America	N	18	0.75	10	0.04	0.5	0.1	5.2	0	N	2020	2017, 2018		SEC
57	Blainville's beaked whale	Gulf of America	N	98	0.46	68	0.04	0.5	0.7	5.2	0	N	2020	2017, 2018	Estimates for *Mesoplodon spp.*	SEC
58	Gervais' beaked whale	Gulf of America	N	20	0.98	10	0.04	0.5	0.1	5.2	0	N	2020	2017, 2018		SEC
59	Common bottlenose dolphin	Gulf of America, Continental Shelf	N	63,280	0.11	57,917	0.04	0.48	556	65	64.6	N	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	Common bottlenose dolphin	Gulf of America, Eastern Coastal	N	16,407	0.17	14,199	0.04	0.4	114	9.2	8.8	N	2021	2017, 2018		SEC
61	Common bottlenose dolphin	Gulf of America, Northern Coastal	N	11,543	0.19	9,881	0.04	0.45	89	28	7.9	N	2021	2017, 2018		SEC
62	Common bottlenose dolphin	Gulf of America, Western Coastal	N	20,759	0.13	18,585	0.04	0.45	167	36	32.4	N	2021	2017, 2018		SEC
63	Common bottlenose dolphin	Gulf of America, Oceanic	N	7,462	0.31	5,769	0.04	0.5	58	32	0	N	2020	2017, 2018		SEC
64	Common bottlenose dolphin	Laguna Madre	N	80	1.57	unk	0.04	0.4	undet	0.8	0.2	Y	2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America 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.
65	Common bottlenose dolphin	Neuces Bay, Corpus Christi Bay	N	58	0.61	unk	0.04	0.4	undet	0.2	0	Y	2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
66	Common bottlenose dolphin	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay	N	55	0.82	unk	0.04	0.4	undet	0.6	0	Y	2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
67	Common bottlenose dolphin	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	N	61	0.45	unk	0.04	0.4	undet	0.4	0	Y	2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
68	Common bottlenose dolphin	West Bay	N	37	0.05	35	0.04	0.4	0.3	0	0	N	2021	2014, 2015		SEC
69	Common bottlenose dolphin	Galveston Bay, East Bay, Trinity Bay	N	842	0.08	787	0.04	0.4	6.3	1.0	0.4	N	2021	2016		SEC
70	Common bottlenose dolphin	Sabine Lake	N	122	0.19	104	0.04	0.45	0.9	0	0	N	2021	2017	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America 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.
71	Common bottlenose dolphin	Calcasieu Lake	N	0	-	-	0.04	0.45	undet	0.2	0.2	Y	2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
72	Common bottlenose dolphin	Vermilion Bay, West Cote Blanche Bay, Atchafalaya Bay	N	0	-	-	0.04	0.45	undet	0	0	Y	2021	1992	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
73	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	Common bottlenose dolphin	Barataria Bay Estuarine System	N	2,071	0.06	1,971	0.04	0.45	18	35	0.2	Y	2023	2019		SEC
75	Common bottlenose dolphin	Mississippi River Delta	N	1,446	0.19	1,238	0.04	0.4	11	9.2	0.2	N	2021	2017–2018	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
76	Common bottlenose dolphin	Mississippi Sound, Lake Borgne, Bay Boudreau	N	1,265	0.35	947	0.04	0.45	8.5	59	2.0	Y	2021	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.
77	Common bottlenose dolphin	Mobile Bay, Bonsecour Bay	N	122	0.34	unk	0.04	0.45	undet	16.0	1.0	Y	2021	1993	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
78	Common bottlenose dolphin	Perdido Bay	N	0	-	-	0.04	0.4	undet	0.8	0.6	Y	2021	1993	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
79	Common bottlenose dolphin	Pensacola Bay, East Bay	N	33	0.80	unk	0.04	0.4	undet	0.4	0.2	Y	2021	1993	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
80	Common bottlenose dolphin	Chocta-whatchee Bay	N	179	0.04	unk	0.04	0.5	undet	0.4	0	Y	2015	2007		SEC
81	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	Common bottlenose dolphin	St. Joseph Bay	N	142	0.17	123	0.04	0.4	1.0	unk	unk	N	2019	2011		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.
83	Common bottlenose dolphin	St. Vincent Sound, Apalachicola Bay, St. George Sound	N	439	0.14	unk	0.04	0.4	undet	0.2	0.2	Y	2021	2007	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
84	Common bottlenose dolphin	Apalachee Bay	N	491	0.39	unk	0.04	0.4	undet	0	0	Y	2021	1993	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
85	Common bottlenose dolphin	Waccasassa Bay, Withla-coochee Bay, Crystal Bay	N	unk	-	unk	0.04	0.4	undet	0.4	0.4	Y	2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
86	Common bottlenose dolphin	St. Joseph Sound, Clearwater Harbor	N	unk	-	unk	0.04	0.4	undet	0.8	0.4	Y	2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
87	Common bottlenose dolphin	Tampa Bay	N	unk	-	unk	0.04	0.4	undet	3.0	2.2	Y	2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America 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.
88	Common bottlenose dolphin	Sarasota Bay, Little Sarasota Bay	N	158	0.27	126	0.04	0.4	1.0	0.2	0.2	N	2021	2015	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
89	Common bottlenose dolphin	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay	N	826	0.09	unk	0.04	0.4	undet	1.0	0.6	Y	2021	2006	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
90	Common bottlenose dolphin	Caloosa-hatchee River	N	0	-	-	0.04	0.4	undet	0.4	0.2	Y	2021	1985	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
91	Common bottlenose dolphin	Estero Bay	N	unk	-	unk	0.04	0.4	undet	0.4	0.2	Y	2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
92	Common bottlenose dolphin	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	N	unk	-	unk	0.04	0.4	undet	0.2	0.2	Y	2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America 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.
93	Common bottlenose dolphin	Whitewater Bay	N	unk	-	unk	0.04	0.4	undet	0	0	Y	2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
94	Common bottlenose dolphin	Florida Bay	N	unk	unk	unk	0.04	0.5	unk	0.2	0.2	N	2022	2003		SEC
95	Common bottlenose dolphin	Florida Keys (Bahia Honda to Key West)	N	unk	-	unk	0.04	0.4	undet	0.2	0.2	Y	2021	n/a	Details for this stock are included in the collective report: Common bottlenose dolphin (*Tursiops truncatus truncatus*), Northern Gulf of America Bay, Sound, and Estuary Stocks.	SEC
96	Atlantic spotted dolphin	Gulf of America	N	21,506	0.26	17,339	0.04	0.48	166	36	36 (0.47)	N	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 America	N	37,195	0.24	30,377	0.04	0.5	304	241	0	N	2020	2017, 2018		SEC
98	Striped dolphin	Gulf of America	N	1,817	0.56	1,172	0.04	0.5	12	13	0	Y	2020	2017, 2018		SEC
99	Spinner dolphin	Gulf of America	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 America	N	unk	n/a	unk	0.04	0.4	undet	39	0.8 (1.00)	N	2020	2017, 2018		SEC
101	Clymene dolphin	Gulf of America	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 America	N	213	1.03	104	0.04	0.5	1.0	unk	0	N	2020	2017, 2018		SEC
103	Killer whale	Gulf of America	N	267	0.75	152	0.04	0.5	1.5	unk	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.
104	False killer whale	Gulf of America	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 America	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 America	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 America	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 America	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 America	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 America	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 America.	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
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

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.
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

CUVIER'S BEAKED WHALE (*Ziphius cavirostris*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Cuvier's beaked whales have a cosmopolitan distribution, found in subpolar to tropical waters in deep waters off the shelf break (Macleod et al. 2006). In the western North Atlantic, strandings have been reported from Nova Scotia along the eastern U.S. coast south to Florida, around the Gulf of America, and within the Caribbean (Leatherwood et al. 1976; CETAP 1982; Heyning 1989; Houston 1990; MacLeod et al. 2006; Jefferson et al. 2008); in addition, they have been acoustically detected as far north as Newfoundland suggesting this species is a transboundary stock (Cohen et al. 2022, Kowarski et al. 2023, Delarue et al. 2024, DeAngelis et al. *in review*).

Cuvier's beaked whale sightings and passive acoustic detections have occurred principally along the continental shelf edge in the Mid-Atlantic region off the northeast U.S. coast, and in waters deeper than 2000 m in the southeast U.S. (CETAP 1982; Waring et al. 1992; Waring et al. 2001; Hamazaki 2002; Palka 2006, DeAngelis et al. *in review*). They have been recorded year-round north of Cape Hatteras near the 1000 m contour, with seasonal peaks during the spring and winter months (Stanistreet et al. 2017, Cohen et al. 2022, 2023), and in the late spring/summer in the southeast U.S. (Kowarski et al. 2023, DeAngelis et al. *in review*) (Fig. 1).

The offshore waters off Cape Hatteras, NC have been shown to host a resident population of Cuvier's beaked whales, with restricted animal movements and little displacement (Foley et al. 2021). As Cuvier's beaked whales have been detected along the entire East Coast of the U.S. and Canada throughout the year, it suggests that there are multiple populations in the western North Atlantic, although the number of populations and their population structure are presently unknown.

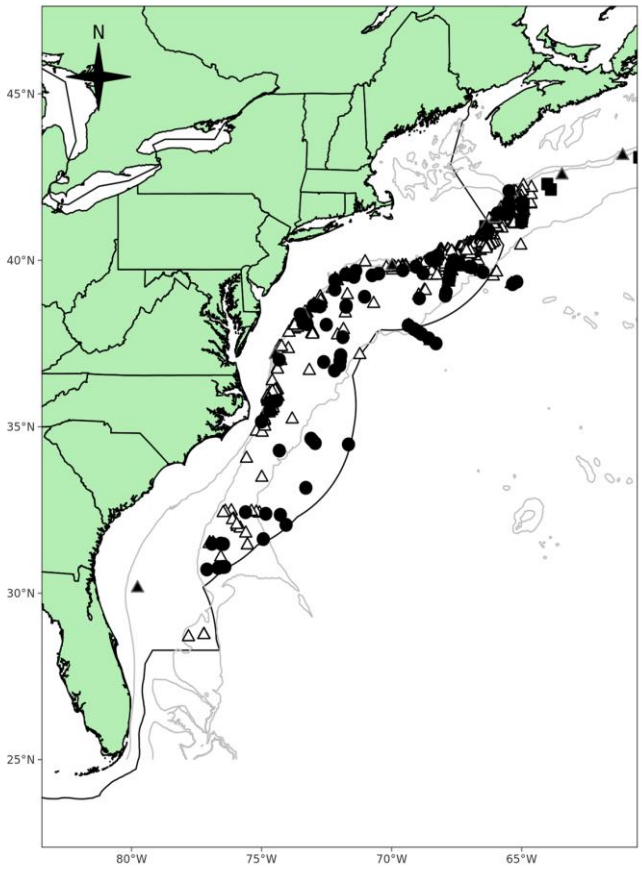


Figure 1. Visual sightings and passive acoustic detections of Cuvier's beaked whale from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006- 2008, 2010, 2011, 2016, and 2021; and DFO's 2007 TNASS and 2016 NAISS surveys; passive acoustic detections from NEFSC shipboard surveys during the summers of 2013-2019, 2021, and spring of 2014, and SEFSC shipboard surveys during the summers of 2013 and 2016; and passive acoustic detections from bottom mounted instruments deployed year round along the 1000-m depth contour from 2012-2020 in U.S. waters (U.S. Navy, NEFSC, SEFSC), and from 2014-2021 in Canadian waters (DFO). Isobaths are the 200-m, 1000-m and 4000-m depth contours. Circle symbols represent shipboard sightings, squares are aerial sightings, open triangles are towed array detections, and filled triangles are detections from bottom mounted passive acoustic instruments.

POPULATION SIZE

The best abundance estimate for Cuvier's beaked whales based on the 2021 survey described below—4,670 (CV=0.24, Garrison and Aichinger-Dias 2023; Palka 2023). This estimate, derived from shipboard surveys, covers the U.S. waters of this stock's known range.

Recent Surveys and Abundance Estimates

Recent abundance estimates of 1,742 (CV=0.39) and 2,928 (CV=0.31) Cuvier's beaked whale were generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2021 (Table

1; Garrison and Aichinger-Dias 2023; Palka 2023). One survey was conducted from 16 June to 23 August in waters north of 36ºN latitude and consisted of 5,871 km of on-effort trackline along the shelf break and offshore to the outer edge of the U.S. EEZ (NEFSC and SEFSC 2022). The second vessel survey covered waters from central Florida (25ºN latitude) to approximately 38ºN latitude between the 200-m isobaths and the outer edge of the U.S. EEZ during 12 June–31 August. A total of 5,659 km of trackline was covered on effort (NEFSC and SEFSC 2022). Both surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and Borchers 2004). Mark-recapture distance sampling was used to estimate abundance. Estimates from the two surveys were combined and CVs pooled to produce an abundance estimate for the stock in U.S. waters.

Table 1. Summary of abundance estimates for the western North Atlantic stock of Cuvier's beaked whales. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV). The estimate considered best is in bold font.

Month/Year	Area	N_{best}	CV
Jun–Aug 2021	New Jersey to lower Bay of Fundy	1,742	0.39
Jun–Aug 2021	Central Florida to New Jersey	2,928	0.31
Jun–Aug 2021	**Central Florida to lower Bay of Fundy (COMBINED)**	**4,670**	**0.24**

Minimum Population Estimate

The minimum population estimate 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 distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the western North Atlantic stock of Cuvier's beaked whales in U.S. waters is 4,670 (CV=0.24). The minimum population estimate for this stock in U.S. waters is 3,817 (Table 2). Despite not covering Canadian waters, given that the survey effort covered most of the stock range, this estimate is assumed to be range-wide

Current Population Trend

A trend analysis has not been conducted for this stock. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval. 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). There is current work to standardize the strata-specific previous abundance estimates to consistently represent the same regions and include appropriate corrections for perception and availability bias. These standardized abundance estimates will be used in state-space trend models that incorporate environmental factors that could potentially influence the process and observational errors for each stratum.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: length at birth is 2 to 3 m, length at sexual maturity is 6.1m for females, and 5.5 m for males, maximum age expressed in dental growth layer groups (GLG's) which are presumed to each correspond to a single year of growth is 30 for for females and 36 for males (Mitchell 1975; Mead 1984; Houston 1990).

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 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 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 western North Atlantic stock of Cuvier's beaked whales in U.S. waters is 3,817. 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 (NMFS 2023). PBR for this stock is 38.

Table 2. Best and minimum abundance estimates for the Western North Atlantic stock of Cuvier's beaked whales with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) and PBR.

N_{est}	CV	N_{min}	F_r	R_{max}	PBR
4,670	0.24	3,817	0.5	0.04	38

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2018-2022 minimum annual rate of human-caused mortality of Cuvier's beaked whales averaged 0.2 animals per year. This is from 1 stranding record that reported signs of human interaction (plastic ingestion; Table 3). This minimum value reflects detected human-caused mortality in U.S. waters only and does not include data from Canada.

Fishery Information

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

In 2018–2022, estimated annual average fishery-related mortality or serious injury of this stock in U.S. fisheries was 0 for all beaked whales. Detailed U.S. fishery information is reported in Appendix III.

STATUS OF STOCK

The western North Atlantic stock of Cuvier's beaked whale is currently not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR. However, as this species occurs in offshore pelagic waters, the detected mortality likely underestimates the true mortality. In addition, the population structure of Cuvier's beaked whales in the western North Atlantic is presently unknown, thus, for now, they are considered as one transboundary stock. The total U.S. fishery mortality and serious injury for this group of species is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. The mortality and/or serious injury of Cuvier's beaked whales in non-U.S. fisheries and in Canadian waters is unknown. The status of Cuvier's beaked whale relative to OSP is unknown. There are insufficient data to determine the population trends. This species is not listed as threatened or endangered under the Endangered Species Act.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Strandings

During 2018-2022, 2 Cuvier's beaked whales stranded along the U.S. Atlantic coast (Table 3; NOAA National Marine Mammal Health and Stranding Response Database, accessed 21 November 2023). The Florida stranding had evidence of human interaction, with trash (appeared to be a wedge of fruit, similar to a small citrus), found in the stomach, though it is unknown if this contributed to the stranding.

Table 3. Cuvier's beaked whale (Ziphius cavirostris) strandings along the U.S. Atlantic coast from 2018-2022.

State	2018	2019	2020	2021	2022	Total
South Carolina	0	0	1	0	0	1
Florida[a]	1	0	0	0	0	1
Total	**1**	**0**	**1**	**0**	**0**	**2**

a. Animal in Florida in 2018 had trash in stomach.

Anthropogenic noise

Anthropogenic noise 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). Cuvier's beaked whales in particular, have been shown to be sensitive to anthropogenic noise, exhibiting behavioral changes in response to shipboard echosounders, ultrasonic anti-fouling devices, and intense shipboard noise (Aguilar Soto et al. 2006, Cholewiak et al. 2017, Trickey et al. 2022). They have also stranded after naval activities (as described in further detail below). The long-term and

population consequences of these impacts are less well-documented. Cuvier's beaked whales off Southern California have been shown to displace from better foraging habitats and forage in poorer quality areas when exposed to naval sonar (DeRuiter et al. 2013, Southall et al. 2019). This response leads to adult survival being a sensitive vital rate in population consequences of disturbance models (Czapanskiy et al. 2021).

Several unusual mass strandings of beaked whales throughout their worldwide range have been associated with naval activities (Cox et al. 2006; D'Amico et al. 2009; Fernandez et al. 2005; Filadelfo et al. 2009). During the mid- to late 1980s multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whale and Blainville's beaked whale occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 were associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998; D'Amico et al. 2009; Filadelfo et al. 2009). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001; NMFS 2001; Cox et al. 2006). Four Cuvier's, 2 Blainville's and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsies of 6 dead beaked whales revealed evidence of tissue damage associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Cox et al. 2006).

Fourteen beaked whales (mostly Cuvier's beaked whales but also including Gervais' and Blainville's beaked whales) stranded in the Canary Islands in 2002 (Cox et al. 2006, Fernandez et al. 2005; Martin et al. 2004). Gas bubble-associated lesions and fat embolism were found in necropsied animals from this event, leading researchers to link nitrogen supersaturation with sonar exposure (Fernandez et al. 2005).

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.

Habitat Issues

Changes in spatial distribution and abundance, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Head et al. 2010; Pinsky et al. 2013; Poloczanska et al. 2013; Hare et al. 2016; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat factors. Results varied by season and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys during 2010 to 2017. There is uncertainty in how, if at all, the changes in distribution and population size of cetacean species may interact with changes in distribution of prey species and how the ecological shifts will affect human impacts to the species.

The chronic impacts of contaminants (polychlorinated biphenyls [PCBs] and chlorinated pesticides [DDT, DDE, dieldrin, etc.]) on marine mammal reproduction and health are of concern (e.g., Pierce et al. 2008; Jepson et al. 2016; Hall et al. 2018; Murphy et al. 2018). Research on contaminant levels for the western north Atlantic beaked whales is lacking, but a recent study shows high levels of contaminants in sampled Cuvier's beaked whales from the Mediterranean subpopulation (Baini et al. 2020).

REFERENCES CITED

Aguilar Soto, N., Johnson, M., Madsen, P.T., Tyack, P.L., Bocconcelli, A. and Fabrizio Borsani, J., 2006. Does intense ship noise disrupt foraging in deep-diving Cuvier's beaked whales (Ziphius cavirostris)?. Marine Mammal Science, 22(3), pp.690-699.

Baini, M., Panti, C., Fossi, M.C., Tepsich, P., Jimenez, B., Coomber, F., Bartalini, A., Munoz-Arnanz, J., Moulins, A., and Rosso, M. 2020. First assessment of POPs and cytochrome P450 expression in Cuvier's beaked whales (Ziphius cavirostris) skin biopsies from the Mediterranean Sea. Scientific Reports 10 (21891). https://doi.org/10.1038/s41598-020-78962-3

Balcomb, K. C.I. and D.E. Claridge 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. 2: 2-12.

Barlow, J., M.C. Fergunson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka and G. Waring 2006. Abundance and densities of beaked and bottlenose whales (family *Ziphiidae*). J. Cetacean Res. Manage. 7: 263-270.

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.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press. 432 pp.

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.

CETAP 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf, final report, Cetacean and Turtle Assessment Program, University of Rhode Island. Washington, DC, Bureau of Land Management. #AA551-CT8-48**:** 576.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580. doi: 10.3389/fmars.2022.877580

Cholewiak, D., DeAngelis, A.I., Palka, D., Corkeron, P.J. and Van Parijs, S.M., 2017. Beaked whales demonstrate a marked acoustic response to the use of shipboard echosounders. Royal Society open science, 4(12), p.170940.

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S., Wiggins, S.M., Rafter, M.A., Baggett, L.M. and Hildebrand, J.A., 2022. Identification of western North Atlantic odontocete echolocation click types using machine learning and spatiotemporal correlates. PloS one, 17(3), p.e0264988.

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S. and Hildebrand, J.A., 2023. Spatial and temporal separation of toothed whales in the western North Atlantic. Marine Ecology Progress Series, 720, pp.1-24.

Cox, T.M., T.J. Ragen, A.J. Read, E. Vos, R.W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G.D. Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P.D. Jepson, D. Ketten, C. D. MacLeod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead and L. Benner 2006. Understanding the impacts of anthropogenic sound on beaked whales. J. Cetacean Res. Manage. 7(3): 177-187.

Czapanskiy, M.F., Savoca, M.S., Gough, W.T., Segre, P.S., Wisniewska, D.M., Cade, D.E. and Goldbogen, J.A., 2021. Modelling short-term energetic costs of sonar disturbance to cetaceans using high-resolution foraging data. Journal of Applied Ecology, 58(8), pp.1643-1657.

D'Amico, A., Gisiner, R.C., Ketten, D.R., Hammock, J.A., Johnson, C., Tyack, P.L., and J. Mead. 2009. Beaked whale strandings and naval exercises. Aq. Mamm. 35(4) 452-472.

DeAngelis, A.I., Stanistreet, J.E., Baumann-Pickering, S. and Cholewiak, D.M., 2018. A description of echolocation clicks recorded in the presence of True's beaked whale (Mesoplodon mirus). The Journal of the Acoustical Society of America, 144(5), pp.2691-2700.

DeAngelis, A. I., Westell, A., Corkeron, P., Solsona Berga, A., Trickey, J., Rafter, M., Baumann-Pickering, S., Cholewiak, D., Soldevilla, M., Bell, J., Van Parijs, S. In review. Niche partitioning of beaked whales (family Ziphiidae) during the summer in the western North Atlantic. Submitted to Marine Ecology Progress Series.

DeRuiter, S.L., Southall, B.L., Calambokidis, J., Zimmer, W.M., Sadykova, D., Falcone, E.A., Friedlaender, A.S., Joseph, J.E., Moretti, D., Schorr, G.S. and Thomas, L., 2013. First direct measurements of behavioural responses by Cuvier's beaked whales to mid-frequency active sonar. Biology letters, 9(4), p.20130223.

Delarue, J.J., Moors-Murphy, H., Kowarski, K.A., Maxner, E.E., Davis, G.E., Stanistreet, J., Martin, S.B., 2024. Acoustic occurrence of beaked whales off eastern Canada, 2015-2017. Endangered Species Research 53: 439-466. https://doi.org/10.3354/esr01314.

Fernandez, A., J.F. Edwards, F. Rodriguez, A.E. de los Monteros, P. Herraez, P. Castro, J.R. Jaber, V. Martin, and M. Arbelo 2005. "Gas and Fat Embolic Syndrome" involving a mass stranding of beaked whales (Family *Ziphiidae*) exposed to anthropogenic sonar signals. Veterinary Pathology 42(4):446-457.

Filadelfo, R., Mintz, J., Michlovich, E., D'Amico, A., Tyack, P.L., and D.R. Ketten. 2009. Correlating military sonar use with beaked whale mass strandings: What do the historical data show? Aq. Mamm.35(4) 435-444.Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392: 29.

Foley, H.J. 2018. Spatial ecology and movement patterns of deep-diving odontocetes in the western North Atlantic ocean. M.S. Thesis. Fisheries, Wildlife, and Conservation Biology, N.C. State University, Raleigh, NC.

Garrison, L.P. and L.A. Dias. 2023. Abundance of marine mammals in waters of the southeastern U.S. Atlantic during summer 2021. SEFSC MMTD Contribution: #MMTD-2023-01. 23 pp. https://repository.library.noaa.gov/view/noaa/49152

Garrison, L.P. 2020. Abundance of cetaceans along the southeast U.S. east coast from a summer 2016 vessel survey. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRD Contribution # PRD-2020-04, 17 pp.

Grieve, B.D., J.A. Hare and V.S. Saba. 2017. Projecting the effects of climate change on *Calanus finmarchicus* distribution within the US Northeast continental shelf. Sci. Rep. 7:6264.

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.

Hare, J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, A.S. Chute, K.L. Curti, T.H. Curtis, D. Kurcheis, J.F. Kocik, S.M. Lucey, C.T. McCandless, L.M. Milke, D.E. Richardson, E. Robillard, H.J. Walsh, M.C. McManus, K.E. Maranick and C.A. Griswold. 2016. A vulnerability assessment of fish and invertebrates to climate change on the Northeast U.S. continental shelf, PLoS ONE 11:e0146756. https://doi.org/10.1371/journal.pone.0146756.s014.

Hall, A.J., B.J. McConnell, L.J. Schwacke, G.M. Ylitalo, R. Williams and T.K. Rowles. 2018. Predicting the effects of polychlorinated biphenyls on cetacean populations through impacts on immunity and calf survival. Environ. Poll. 233:407–418.

Head, E.J.H., and P. Pepin. 2010. Spatial and inter-decadal variability in plankton abundance and composition in the Northwest Atlantic (1958–2006). J. Plankton Res. 32:1633–1648.

Hamazaki, T. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, No. Carolina, USA to Nova Scotia, Canada). Mar. Mamm. Sci. 18(4): 920-939.

Heyning, J.E. 1989. Cuvier's beaked whale, *Ziphius cavirostris* G. Cuvier, 1823. Pages 289-308 *in*: S.H. Ridgway and R. Harrison, (eds.) Handbook of Marine Mammals, Vol. 4: River dolphins and larger toothed whales. Academic Press, London.

Houston, J. 1990. Status of Blainville's beaked whale, *Mesoplodon densirostris*, in Canada. Can. Field-Nat. 104(1): 117-120.

Jefferson, T.A., Webber, M.A., and R.L. Pitman. 2008. Marine Mammals of the World. Elsevier, Amsterdam Netherlands. 573 pp.

Jepson, P.D., R. Deaville, J.L. Barber, A. Aguilar, A. Borrell, S. Murphy, J. Barry, A. Brownlow, J. Barnett, S. Berrow and A.A. Cunningham. 2016. PCB pollution continues to impact populations of orcas and other dolphins in European waters. Sci. Rep.-U.K. 6:18573.

Kowarski, K.A., Martin, S.B., Maxner, E.E., Lawrence, C.B., Delarue, J.J.Y. and Miksis-Olds, J.L., 2023. Cetacean acoustic occurrence on the US Atlantic Outer Continental Shelf from 2017 to 2020. Marine Mammal Science, 39(1), pp.175-199.

Laake, J. L., and D. L. Borchers. 2004. Methods for incomplete detection at distance zero. Pages 108-189 *in*: S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.), Advanced distance sampling. Oxford University Press, New York, New York.Leatherwood, S., D.K. Caldwell and H.E. Winn 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. NOAA Tech. Rep. NMFS Circ. 396. 176 pp.

Longhurst, A.R. 2007. Ecological geography of the sea, second edition. Elsevier Academic Press, Boston, Massachusetts. 560 pp.

Lucas, Z. N. and S. K. Hooker 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114(1): 46-61.

Martín, V., A. Servidio, and S. García 2004. Mass strandings of beaked whales in the Canary Islands. ECS Newsletter 42:33–6.
MacLeod, C., W.F. Perrin, R. Pitman, J. Barlow, L. Ballance, A. D'Amico, T. Gerrodette, G. Joyce, K.D. Mullin, D. L. Palka and G.T. Waring 2006. Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). J. Cetacean Res. Manage. 7(3): 271–286.
MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. Endang. Species Res. 7:125–136.
McLellan, W.A, R.J. McAlarney, E.W. Cummings, A.J. Read, C.G.M. Paxton, J.T. Bell and D.A. Pabst. 2018. Year-round distribution and abundance of multiple beaked whale species (Family Ziphiidae) off Cape Hatteras, North Carolina, USA. Mar. Mamm.Sci. 34: 997–1017.
Mead, J.G. 1984. Survey of reproductive data for the beaked whales (*Ziphiidae*). Rep. Int. Whal. Comm. (Special Issue) 6: 91-96.
Mead, J.G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430 *in*: S.H. Ridgway and R. Harrison, (eds.) Handbook of marine mammals, Vol. 4: River Dolphins and toothed whales. Academic press, San Diego.
Mitchell, E.D., (ed.), 1975. Review of the biology and fisheries for smaller cetaceans. Report of the meeting on smaller cetaceans. Int. Whal. Comm. J. Fish. Res. Board Can 32(7): 875–1240.
Morley, J.W., R.L. Selden, R.J. Latour, T.L. Frolicher, R.J. Seagraves and M.L. Pinsky. 2018. Projecting shifts in thermal habitat for 686 species on the North American continental shelf. PLoS ONE 13(5):e0196127.
Murphy, S., R.J. Law, R. Deaville, J.Barnett, M W. Perkins, A. Brownlow, R. Penrose, N.J. Davison, J.L. Barber P.D. Jepson. 2018. Organochlorine contaminants and reproductive implication in cetaceans: A case study of the common dolphin. Pages 3–38 *in* M.C. Fossi and C. Panti, (eds.) Marine mammal ecotoxicology:Impacts of multiple stressors on population health. Academic Press, New York, New York.
NMFS 2001. Joint interim report on the Bahamas marine mammal stranding event of 15-16 March 2000 (December 2001). NOAA unpublished report 55 pp. https://repository.library.noaa.gov/view/noaa/16198
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. NOAA Tech. Memo. NMFS-OPR-59, 167 pp. Available from: https://repository.library.noaa.gov/view/noaa/17892
NMFS 2023. Guidelines for Preparing Stock Assessment Reports Pursuant to the Marine Mammal Protection Act. Protected Resources Policy Directive 02-204-01.
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.
Nye, J., J. Link, J. Hare and W. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Mar. Ecol. Prog. Ser. 393:111–129.
Palka, D. L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. https://repository.library.noaa.gov/view/noaa/5258.
Palka, D. 2020. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2016 line transect surveys conducted by the Northeast Fisheries Science Center. Northeast Fish. Sci. Cent. Ref. Doc. 20-05.
Palka, D.L. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. Northeast Fish. Sci. Cent. Ref. Doc. 12-29. 37 pp. https://repository.library.noaa.gov/view/noaa/4312
Palka, DL. in prep. Cetacean abundance in the US Northwestern Atlantic Ocean summer 2021. Northeast Fish. Sci. Cent. Ref. Doc.
Pierce, G.J. M.B. Santos, S. Murphy, J.A. Learmonth, A.F. Zuur, E. Rogan, P. Bustamante, F. Caurant, V. Lahaye, V. Ridoux, B.N. Zegers, A. Mets, M. Addink, C. Smeenk, T. Jauniaux, R.J. Law, W. Dabin, A. López, J.M. Alonso Farré, A.F. González, A. Guerra, M. García-Hartmann, R.J. Reid, C.F. Moffat, C. Lockyer, J.P. Boon. 2008. Bioaccumulation of persistent organic pollutants in female common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*) from western European seas: Geographical trends, causal factors and effects on reproduction and mortality. Environmental Pollution. 153:401–415.
Pinsky, M.L., B. Worm, M.J. Fogarty, J.L. Sarmiento and S.A. Levin. 2013. Marine taxa track local climate velocities. Science 341:1239–1242.
Poloczanska, E.S., C.J. Brown, W.J. Sydeman, W. Kiessling, D.S. Schoeman, P.J. Moore, K. Brander, J.F. Bruno, L.B. Buckley, M.T. Burrows, C.M. Duarte, B.S. Halpern, J. Holding, C.V. Kappel, M.I. O'Connor, J.M.

Pandolfi, C. Parmesan, F. Schwing, S.A. Thompson and A.J. Richardson. 2013. Global imprint of climate change on marine life. Nat. Clim. Change 3:919–925.
Simmonds, M.P. and L.F. Lopez-Jurado 1991. Whales and the military. Nature 351(6326): 448–448.
Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.
Southall, B.L., Benoit-Bird, K.J., Moline, M.A. and Moretti, D., 2019. Quantifying deep-sea predator–prey dynamics: Implications of biological heterogeneity for beaked whale conservation. Journal of Applied Ecology, 56(5), pp.1040-1049.
Spalding, M.D., H.E. Fox, G.R. Allen, N. Davidson, Z.A. Ferdaña, M. Finlayson, B.S. Halpern, M.A. Jorge, A. Lombana, S.A. Lourie, K.D. Martin, E. McManus, J. Molnar, C.A. Recchia and J. Robertson. 2007. Marine ecoregions of the world: a bioregionalization of coastal and shelf areas. BioScience 57:573–583.
Stanistreet, J., D.P. Nowacek, S. Baumann-Pickering, J.T. Bell, D.M. Cholewiak, J.A. Hildebrand, L.E. Hodge, H.B. Moors-Murphy, S.M. Van Parijs and A.J. Read. 2017. Using passive acoustic monitoring to document the distribution of beaked whale species in the western North Atlantic Ocean. Can. J. of Fish. & Aq. Sci. 74: 2098–2109.
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(1): 157-175.
Thomas L, J.L. Laake, E. Rexstad, S. Strindberg, F.F.C. Marques, S.T. Buckland, D.L. Borchers, D.R. Anderson, K.P. Burnham, M.L. Burt, S.L. Hedley, J.H. Pollard, J.R.B. Bishop and T.A. Marques. 2009. Distance 6.0. Release 2. [Internet]. University of St. Andrews (UK): Research Unit for Wildlife Population Assessment. Available from: http://distancesampling.org/Distance/.
Trickey, J.S., Cárdenas-Hinojosa, G., Rojas-Bracho, L., Schorr, G.S., Rone, B.K., Hidalgo-Pla, E., Rice, A. and Baumann-Pickering, S., 2022. Ultrasonic antifouling devices negatively impact Cuvier's beaked whales near Guadalupe Island, México. Communications Biology, 5(1), p.1005.
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. Available from: https://repository.library.noaa.gov/view/noaa/15963
Waring, G.T., C.P. Fairfield, C.M. Ruhsam and M. Sano 1992. Cetaceans associated with Gulf Stream features off the Northeastern USA Shelf. ICES [Int. Counc. Explor. Sea] C.M. 1992/N:12.
Waring, G.T., T. Hamazaki, D. Sheehan, G. Wood and S. Baker 2001. Characterization of beaked whale (*Ziphiidae*) and sperm whale (*Physeter macrocephalus*) summer habitat in shelf-edge and deeper waters off the northeast U.S. Mar. Mamm. Sci. 17(4): 703–717.

BLAINVILLE'S BEAKED WHALE (*Mesoplodon densirostris*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Blainville's beaked whales are a pelagic species, primarily found in tropical to warm temperate waters (Macleod et al. 2006). The family of beaked whales is difficult to visually classify to the species level, but easily distinguishable through passive acoustics (Baumann-Pickering et al. 2013). The population structure for Blainville's beaked whales in the North Atlantic is presently unknown. The geographic distribution reported here is primarily based on recordings collected by various passive acoustic devices deployed from 2012─2021, including instruments that were deployed year-round.

Blainville's beaked whales are found to occur within the Gulf Stream, being acoustically detected from Florida to Cape Hatteras, NC (Stanistreet et al. 2017, Cohen et al. 2022, Kowarski et al. 2023, DeAngelis et al. *in revision*). Passive acoustic sensors were not placed in the Gulf Stream north of Cape Hatteras; thus, it is uncertain whether their range extends further north in deeper waters containing the Gulf Stream. However, they are considered rare in Canadian waters (Houston 1990), though there are records of two strandings in Nova Scotia which probably represent strays from the Gulf Stream (Mead 1989). The species has not been acoustically detected in the summer shipboard surveys north of Cape Hatteras, NC but were sighted infrequently off of Long Island, NY and off of Nova Scotia (Figure 1).

Most acoustic detections of Blainville's beaked whales occurred year-round off Georgia and Florida in 800 - 1000 m water depth (Cohen et al. 2022, Kowarski et al. 2023). Cohen et al. (2023) found that at the monitoring site off of Georgia's coast, Blainville's beaked whale detections, while present year-round, peaked during the late winter months.

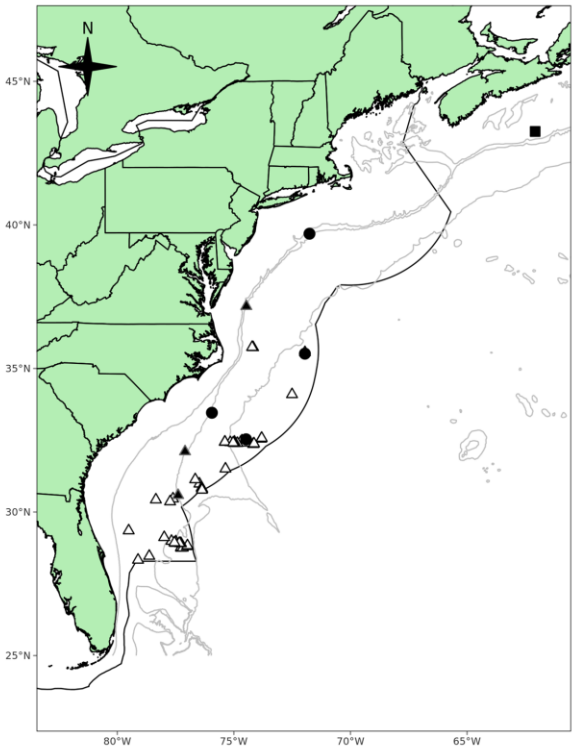


Figure 1. Distribution of Blainville's beaked whale using sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006- 2008, 2010, 2011, 2016, and 2021; and DFO's 2007 TNASS and 2016 NAISS surveys; passive acoustic detections from NEFSC shipboard surveys during the summers of 2013-2019, 2021, and spring of 2014, and SEFSC shipboard surveys during the summers of 2013 and 2016; and passive acoustic detections from bottom mounted instruments deployed year round along the 1000-m depth contour from 2012-2020 in U.S. waters (U.S. Navy, NEFSC, SEFSC), and from 2014-2021 in Canadian waters (DFO). Isobaths are the 200-m, 1000-m and 4000-m depth contours. Circle symbols represent shipboard sightings, squares are aerial sightings, open triangles are towed array detections, and filled triangles are detections from bottom mounted passive acoustic instruments.

POPULATION SIZE

The best abundance estimate for Blainville's beaked whales is the 2021 survey estimate: 2,936 (CV=0.26). This estimate, derived from shipboard surveys, covers most of this stock's known range. In the 2021 survey, improvements to field protocols for both visual observers combined with simultaneous passive acoustic monitoring of *Mesoplodon* spp. facilitated differentiation of species during encounters. This enabled abundance estimates to be calculated for each species individually rather than grouping together at the genus level.

Recent Surveys and Abundance Estimates

Prior to 2021, abundance estimates were of pooled *Mesoplodon* spp. With the improvements to the field protocols allowing the reporting of beaked whale species specific abundance estimates, the estimates of pooled species abundances are no longer reported in the stock assessment reports. An abundance estimate of 2,936 (CV=0.26) Blainville's beaked whales was generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2021 (Table 1; Garrison and Dias 2023; Palka 2023). One survey was conducted from 16 June to 23 August in waters north of 36ºN latitude and consisted of 5,871 km of on-effort trackline along the shelf break and offshore to the outer edge of the U.S. EEZ (NEFSC and SEFSC 2022). The second vessel survey covered waters from central Florida (25ºN latitude) to approximately 38ºN latitude between the 200-m isobaths and the outer edge of the U.S. EEZ during 12 June–31 August. A total of 5,659 km of trackline was covered on effort (NEFSC and SEFSC 2022). Both surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and Borchers 2004). Mark-recapture distance sampling was used to estimate abundance. Estimates from the two surveys were combined and CVs pooled to produce a species abundance estimate for the stock area.

Table 1. Summary of abundance estimates for Blainville's beaked whales (2021 surveys). Month, year, area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV) are represented. The estimate considered best is in bold font.

Month/Year	Area	N_{best}	CV
Jun–Aug 2021	New Jersey to lower Bay of Fundy	0	0
Jun–Aug 2021	Central Florida to New Jersey	2,936	0.26
Jun–Aug 2021	**Central Florida to lower Bay of Fundy (COMBINED)**	**2,936**	**0.26**

Minimum Population Estimate

The minimum population estimate 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 distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the western North Atlantic stock of Blainville's beaked whales is 2,936 (CV=0.26). The minimum population estimate for this stock is 2,374.

Current Population Trend

A trend analysis has not been conducted for this stock. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval. 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). There is current work to standardize the strata-specific previous abundance estimates to consistently represent the same regions and include appropriate corrections for perception and availability bias. These standardized abundance estimates will be used in state-space trend models that incorporate environmental factors that could potentially influence the process and observational errors for each stratum.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. *Mesoplodon densirostris* life history parameters that could be used to estimate net productivity include: length at birth of up to 1.9 m, maximum reported adult length of 4.7, and minimum reported age at sexual maturity of 9 dental growth layer groups (GLG's), which may each correspond to a single year of growth (Mead 1984).

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 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 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 Blainville's beaked whales is 2,374. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5. PBR for Blainville's beaked whales in the western North Atlantic is 24.

Table 2. Best and minimum abundance estimates for Blainville's beaked whales (*Mesoplodon densirostris*) of the Western North Atlantic with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) and PBR.

N_{est}	CV N_{est}	N_{min}	F_r	R_{max}	PBR
2,936	0.26	2,374	0.5	0.04	24

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2018–2022 total average estimated annual human-caused mortality for the western North Atlantic stock Blainville's beaked whales is 0 (Table 3). Despite not covering Canadian waters, given that the survey effort covered most of the stock range, this estimate is assumed to be range-wide.

Table 3. Total annual estimated average human-caused mortality and serious injury for the North Atlantic stock of Blainville's beaked whales (*Mesoplodon densirostris*).

Years	Source	Annual Avg.	CV
2018–2022	U.S. fisheries using observer data	0	NA
TOTAL		NA	NA

Fishery Information

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock that occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

In 2018-2022, estimated annual average fishery-related mortality or serious injury of this stock in U.S. fisheries was 0 for all beaked whales.

Other Mortality

From 2018–2022, a total of 3 Blainville's beaked whales stranded along the U.S. Atlantic coast between Florida and Massachusetts (NOAA National Marine Mammal Health and Stranding Response Database, accessed 21 November 2023, Table 4). None of these mortalities were determined to be due to human interactions.

Table 4. Blainville's beaked whale (*Mesoplodon densirostris*) strandings along the U.S. Atlantic coast.

State	2018	2019	2020	2021	2022	Total
Maine	0	0	1	0	0	1
North Carolina	0	1	0	0	0	1
South Carolina	1	0	0	0	0	1
Total	**1**	**1**	**1**	**0**	**0**	**3**

STATUS OF STOCK

Blainville's beaked whales are not listed as threatened or endangered under the Endangered Species Act and the western North Atlantic stock of Blainville's beaked whale is currently not considered strategic under the Marine Mammal Protection Act. There are insufficient data to determine the population trends. As this species occurs in offshore pelagic waters, the observed mortality likely underestimates the true mortality. In addition, the population structure of Blainville's beaked whales in the western North Atlantic is presently unknown, thus, for now, they are

considered one stock. The permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality, and no fishery-related mortality and serious injury has been observed during the recent 5-year (2018–2022) period. Therefore, total U.S. fishery-related mortality and serious injury rate is considered insignificant and approaching zero. The mortality and/or serious injury of Blainville's beaked whales in non-U.S. fisheries is unknown. The status of Blainville's beaked whales relative to OSP is unknown.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Anthropogenic noise

Anthropogenic noise 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). Blainville's beaked whales have been shown to suspend foraging activities to relocate to other areas with lower levels/no military sonar (Tyack et al. 2011, McCarthy et al. 2011, Moretti et al. 2014, Joyce et al. 2019). However, interindividual variability has been observed, and in one study, not all animals from a population were displaced (Joyce et al. 2019). 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.

Several unusual mass strandings of beaked whales throughout their worldwide range have been associated with naval activities (D'Amico et al. 2009; Filadelfo et al. 2009). During the mid- to late 1980s multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whale and Blainville's beaked whales occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12–13 May 1996 were associated with low-frequency sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998; D'Amico et al. 2009; Filadelfo et al. 2009). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001; NMFS 2001; Cox et al. 2006). Four Cuvier's, 2 Blainville's, and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsy of 6 dead beaked whales revealed evidence of tissue damage associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Cox et al. 2006).

Fourteen beaked whales (mostly Cuvier's beaked whales but also including Gervais' and Blainville's beaked whales) stranded in the Canary Islands in 2002 (Martin et al. 2004; Fernandez et al. 2005; Cox et al. 2006). Gas bubble-associated lesions and fat embolism were found in necropsied animals from this event, leading researchers to link nitrogen supersaturation with sonar exposure (Fernandez et al. 2005).

Habitat issues

Changes in spatial distribution and abundance, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Head et al. 2010; Pinsky et al. 2013; Poloczanska et al. 2013; Hare et al. 2016; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat factors. Blainville's beaked whales were not specifically analyzed in that study, and there is uncertainty in how, if at all, the changes in distribution and population size of cetacean species may interact with changes in distribution of prey species and how the ecological shifts will affect human impacts to the species.

The chronic impacts of contaminants (polychlorinated biphenyls [PCBs] and chlorinated pesticides [DDT, DDE, dieldrin, etc.]) on marine mammal reproduction and health are of concern (e.g., Pierce et al. 2008; Jepson et al. 2016; Hall et al. 2018; Murphy et al. 2018), but research on contaminant levels for the western north Atlantic beaked whales is lacking.

REFERENCES CITED

Balcomb, K.C. III, and D.E. Claridge. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. 2:2–12.

Barlow, J., M.C. Ferguson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka and G. Waring. 2006. Abundance and densities of beaked and bottlenose whales (family Ziphiidae). J. Cetacean Res. Manage. 7:263–270.

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.

Baumann-Pickering, S., McDonald, M.A., Simonis, A.E., Solsona Berga, A., Merkens, K.P., Oleson, E.M., Roch, M.A., Wiggins, S.M., Rankin, S., Yack, T.M. and Hildebrand, J.A., 2013. Species-specific beaked whale echolocation signals. The Journal of the Acoustical Society of America, 134(3), pp.2293-2301.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, London, UK. 432 pp.

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.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf, final report AA551-CT8-48, Cetacean and Turtle Assessment Program, University of Rhode Island. Bureau of Land Management, Washington, D.C. 576 pp.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580. doi: 10.3389/fmars.2022.877580

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S., Wiggins, S.M., Rafter, M.A., Baggett, L.M. and Hildebrand, J.A., 2022. Identification of western North Atlantic odontocete echolocation click types using machine learning and spatiotemporal correlates. PloS one, 17(3), p.e0264988.

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S. and Hildebrand, J.A., 2023. Spatial and temporal separation of toothed whales in the western North Atlantic. Marine Ecology Progress Series, 720, pp.1-24.

Cox, T.M., T.J. Ragen, A.J. Read, E. Vos, R.W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D. Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hilderbrand, D. Houser, T. Hullar, P.D. Jepson, D. Ketten, C.D. MacLeod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead and L. Benner. 2006. Understanding the impacts of anthropogenic sound on beaked whales. J. Cetacean Res. Manage. 7:177–187.

D'Amico, A., R.C.Gisiner, D.R. Ketten, J.A Hammock, C. Johnson., P.L. Tyack and J. Mead. 2009. Beaked whale strandings and naval exercises. Aq. Mamm. 35:452–472.

DeAngelis, A. I., Westell, A., Corkeron, P., Solsona Berga, A., Trickey, J., Rafter, M., Baumann-Pickering, S., Cholewiak, D., Soldevilla, M., Bell, J., Van Parijs, S. In revision. Niche partitioning of beaked whales (family Ziphiidae) during the summer in the western North Atlantic. Submitted to Marine Ecology Progress Series.

Fernandez, A., J.F. Edwards, F. Rodriguez, A.E. de los Monteros, P. Herraez, P. Castro, J.R. Jaber, V. Martin and M. Arbelo 2005. "Gas and Fat Embolic Syndrome" involving a mass stranding of beaked whales (Family Ziphiidae) exposed to anthropogenic sonar signals. Vet. Pathol. 42:446–457.

Filadelfo, R., J. Mintz, E. Michlovich, A. D'Amico, P.L Tyack and D.R. Ketten. 2009. Correlating military sonar use with beaked whale mass strandings: What do the historical data show? Aq. Mamm. 35:435–444.

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392:29.

Garrison, L.P. 2020. Abundance of cetaceans along the southeast U.S. east coast from a summer 2016 vessel survey. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRD Contribution # PRD-2020-04, 17 pp.

Garrison, L.P. and L.A. Dias. 2023. Abundance of marine mammals in waters of the southeastern U.S. Atlantic during summer 2021. SEFSC MMTD Contribution: #MMTD-2023-01. 23 pp. https://repository.library.noaa.gov/view/noaa/49152

Grieve, B.D., J.A. Hare and V.S. Saba. 2017. Projecting the effects of climate change on *Calanus finmarchicus* distribution within the US Northeast continental shelf. Sci. Rep. 7:6264.

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.

Hare, J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, A.S. Chute, K.L. Curti, T.H. Curtis, D. Kurcheis, J.F. Kocik, S.M. Lucey, C.T. McCandless, L.M. Milke, D.E. Richardson, E. Robillard, H.J. Walsh, M.C. McManus, K.E. Maranick and C.A. Griswold. 2016. A vulnerability assessment of fish and invertebrates to climate change on the Northeast U.S. continental shelf, PLoS ONE 11:e0146756. https://doi.org/10.1371/journal.pone.0146756.s014.

Hall, A.J., B.J. McConnell, L.J. Schwacke, G.M. Ylitalo, R. Williams and T.K. Rowles. 2018. Predicting the effects of polychlorinated biphenyls on cetacean populations through impacts on immunity and calf survival. Environ. Poll. 233:407–418.

Head, E.J.H., and P. Pepin. 2010. Spatial and inter-decadal variability in plankton abundance and composition in the Northwest Atlantic (1958–2006). J. Plankton Res. 32:1633–1648.

Houston, J. 1990. Status of Blainville's beaked whale, *Mesoplodon densirostris*, in Canada. Can. Field-Nat. 104:117–120.

Jepson, P.D., R. Deaville, J.L. Barber, A. Aguilar, A. Borrell, S. Murphy, J. Barry, A. Brownlow, J. Barnett, S. Berrow and A.A. Cunningham. 2016. PCB pollution continues to impact populations of orcas and other dolphins in European waters. Sci. Rep.-U.K. 6:18573.

Joyce, T.W., Durban, J.W., Claridge, D.E., Dunn, C.A., Hickmott, L.S., Fearnbach, H., Dolan, K. and Moretti, D., 2020. Behavioral responses of satellite tracked Blainville's beaked whales (Mesoplodon densirostris) to mid-frequency active sonar. Marine Mammal Science, 36(1), pp.29-46.

Kowarski, K.A., Martin, S.B., Maxner, E.E., Lawrence, C.B., Delarue, J.J.Y. and Miksis-Olds, J.L., 2023. Cetacean acoustic occurrence on the US Atlantic Outer Continental Shelf from 2017 to 2020. Marine Mammal Science, 39(1), pp.175-199.

Laake, J. L., and D. L. Borchers. 2004. Methods for incomplete detection at distance zero. Pages 108-189 *in*: S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.), Advanced distance sampling. Oxford University Press, New York, New York.

Leatherwood, S., D.K. Caldwell and H.E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. NOAA Tech. Rep. NMFS Circ. 396. 176 pp.

Lucas, Z.N., and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114:46–61.

Martín, V., A. Servidio and S. García. 2004. Mass strandings of beaked whales in the Canary Islands. ECS Newsletter 42:33–36.

MacLeod, C., W.F. Perrin, R. Pitman, J. Barlow, L. Ballance, A. D'Amico, T. Gerrodette, G. Joyce, K.D. Mullin, D.L. Palka and G.T. Waring. 2006. Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). J. Cetacean Res. Manage. 7:271–286.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. Endang. Species Res. 7:125–136.

McCarthy, E., Moretti, D., Thomas, L., DiMarzio, N., Morrissey, R., Jarvis, S., Ward, J., Izzi, A. and Dilley, A., 2011. Changes in spatial and temporal distribution and vocal behavior of Blainville's beaked whales (Mesoplodon densirostris) during multiship exercises with mid-frequency sonar. Marine Mammal Science, 27(3), pp.E206-E226.

Mead, J.G. 1984. Survey of reproductive data for the beaked whales (Ziphiidae). Rep. Int. Whal. Comm. (Special Issue) 6:91–96.

Mead, J.G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430 in: S.H. Ridgway and R. Harrison (eds.). Handbook of marine mammals, Vol. 4: River Dolphins and the larger toothed whales. Academic Press, San Diego, California.

Moretti, D., Thomas, L., Marques, T., Harwood, J., Dilley, A., Neales, B., Shaffer, J., McCarthy, E., New, L., Jarvis, S. and Morrissey, R., 2014. A risk function for behavioral disruption of Blainville's beaked whales (Mesoplodon densirostris) from mid-frequency active sonar. PloS one, 9(1), p.e85064.

Morley, J.W., R.L. Selden, R.J. Latour, T.L. Frolicher, R.J. Seagraves and M.L. Pinsky. 2018. Projecting shifts in thermal habitat for 686 species on the North American continental shelf. PLoS ONE 13(5):e0196127.

Murphy, S., R.J. Law, R. Deaville, J.Barnett, M W. Perkins, A. Brownlow, R. Penrose, N.J. Davison, J.L. Barber P.D. Jepson. 2018. Organochlorine contaminants and reproductive implication in cetaceans: A case study of the common dolphin. Pages 3–38 *in* M.C. Fossi and C. Panti, (eds.) Marine mammal ecotoxicology:Impacts of multiple stressors on population health. Academic Press, New York, New York.

Nawojchik, R. 1994. First record of *Mesoplodon densirostris* (Cetacea: Ziphiidae) from Rhode Island. Mar. Mamm. Sci. 10:477–480.

NMFS 2001. Joint interim report on the Bahamas marine mammal stranding event of 15-16 March 2000 (December 2001). NOAA unpublished report. 55 pp. https://repository.library.noaa.gov/view/noaa/16198

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. 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.

Nye, J., J. Link, J. Hare and W. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Mar. Ecol. Prog. Ser. 393:111–129.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. https://repository.library.noaa.gov/view/noaa/5258

Palka, D.L. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. Northeast Fish. Sci. Cent. Ref. Doc. 12-29. 37 pp. https://repository.library.noaa.gov/view/noaa/4312

Palka, D. 2020. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2016 line transect surveys conducted by the Northeast Fisheries Science Center. Northeast Fish. Sci. Cent. Ref. Doc. 20-05.

Palka, DL. 2023. Cetacean abundance in the US Northwestern Atlantic Ocean, Summer 2021. Northeast Fish. Sci. Cent. Ref. Doc. 23-08.

Pierce, G.J. M.B. Santos, S. Murphy, J.A. Learmonth, A.F. Zuur, E. Rogan, P. Bustamante, F. Caurant, V. Lahaye, V. Ridoux, B.N. Zegers, A. Mets, M. Addink, C. Smeenk, T. Jauniaux, R.J. Law, W. Dabin, A. López, J.M. Alonso Farré, A.F. González, A. Guerra, M. García-Hartmann, R.J. Reid, C.F. Moffat, C. Lockyer, J.P. Boon. 2008. Bioaccumulation of persistent organic pollutants in female common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*) from western European seas: Geographical trends, causal factors and effects on reproduction and mortality. Environmental Pollution. 153:401–415.

Pinsky, M.L., B. Worm, M.J. Fogarty, J.L. Sarmiento and S.A. Levin. 2013. Marine taxa track local climate velocities. Science 341:1239–1242.

Poloczanska, E.S., C.J. Brown, W.J. Sydeman, W. Kiessling, D.S. Schoeman, P.J. Moore, K. Brander, J.F. Bruno, L.B. Buckley, M.T. Burrows, C.M. Duarte, B.S. Halpern, J. Holding, C.V. Kappel, M.I. O'Connor, J.M. Pandolfi, C. Parmesan, F. Schwing, S.A. Thompson and A.J. Richardson. 2013. Global imprint of climate change on marine life. Nat. Clim. Change 3:919–925.

Simmonds, M.P., and L.F. Lopez-Jurado 1991. Whales and the military. Nature 351:448.

Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.

Stanistreet, J.E., Nowacek, D.P., Baumann-Pickering, S., Bell, J.T., Cholewiak, D.M., Hildebrand, J.A., Hodge, L.E., Moors-Murphy, H.B., Van Parijs, S.M. and Read, A.J., 2017. Using passive acoustic monitoring to document the distribution of beaked whale species in the western North Atlantic Ocean. Canadian Journal of Fisheries and Aquatic Sciences, 74(12), pp.2098-2109.

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.

Tove, M. 1995. Live sighting of *Mesoplodon cf. M. mirus*, True's beaked whale. Mar. Mamm. Sci. 11:80–85.

Tyack, P.L., Zimmer, W.M., Moretti, D., Southall, B.L., Claridge, D.E., Durban, J.W., Clark, C.W., D'Amico, A., DiMarzio, N., Jarvis, S. and McCarthy, E., 2011. Beaked whales respond to simulated and actual navy sonar. PloS one, 6(3), p.e17009.

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. Available from: https://repository.library.noaa.gov/view/noaa/15963

GERVAIS' BEAKED WHALE (*Mesoplodon europaeus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Gervais' beaked whales are a deep-water species known to inhabit warm temperate to tropical waters (Macleod et al. 2006). The family of beaked whales is difficult to visually classify to the species level, especially True's and Gervais' beaked whales, which are often misidentified visually (Tove 1995, Aguilar de Soto et al. 2017) and prove difficult to distinguish acoustically (DeAngelis et al. 2018). However, due to the increased use of high-definition photography it has been possible to improve training of visual observers. Thus, when an observer is provided with a good look at a beaked whale when viewed through high powered binoculars, it is often possible to distinguish them. Until further Gervais' signals are characterized, some passive acoustic studies use a combined "Gervais'/True's" class when uncertain (Kowarski et al. 2023, Delarue et al. 2024, DeAngelis et al. *in revision*). The geographic distribution reported below is primarily based on acoustic recordings collected from 2012─2021, including instruments that were deployed year-round.

Gervais' beaked whales in the western North Atlantic exhibit a strong preference for Gulf Stream waters, most commonly along the southeast of the U.S. north to Cape Hatteras, NC, but can also be found in deeper waters off the northeast containing the Gulf Stream (Cohen et al. 2022, 2023, DeAngelis et al. *in review*, Figure 1). Using stationary passive acoustic recorders, Gervais' beaked whales have been detected throughout the year, with a peak in detections in the late summer to winter months in the southeast U.S. (Cohen et al. 2023). Elevated presence relative to the rest of the East Coast of the U.S. was noted in the offshore waters of South Carolina (Stanistreet et al. 2017, Kowarski et al. 2023, DeAngelis et al. *in review*). Strandings have been reported from Cape Cod to Florida, into the Caribbean and the Gulf of America (NMFS unpublished data; Leatherwood et al. 1976; Mead 1989; Moore et al. 2005; MacLeod et al. 2006; Jefferson et al. 2008; McLellan et al. 2018). This is the most common species of *Mesoplodon* to strand along the U.S. Atlantic coast. With visual sightings occurring in Canadian waters greater than 4000 m depth (Figure 1), Gervais' beaked whales are a transboundary stock.

If including passive acoustic detections in the combined "Gervais'/True's" class, the distribution of Gervais' beaked whale could be extended north to the Grand Banks of Newfoundland (Delarue et al. 2024). However, the authors noted that these detections had characteristics aligning more with True's beaked whale clicks than Gervais' beaked whale. It is possible that Gervais' beaked whales could occur closer inshore along the 1000 m contour in the mid-Atlantic; however, most of these detections were in the combined "Gervais'/True's" class (DeAngelis et al. *in review*).

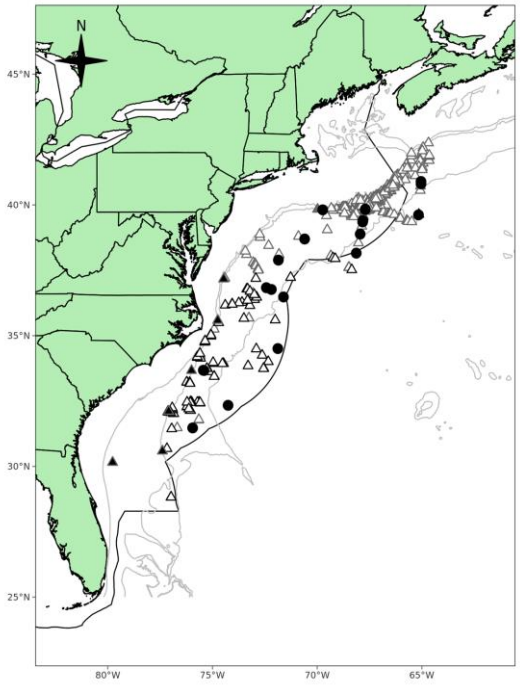


Figure 1. Visual sightings and passive acoustic detections of Gervais' beaked whale (includes* Gervais'/True's passive acoustic detections*) using sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006- 2008, 2010, 2011, 2016, and 2021; and DFO's 2007 TNASS and 2016 NAISS surveys; passive acoustic detections from NEFSC shipboard surveys during the summers of 2013-2019, 2021, and spring of 2014, and SEFSC shipboard surveys during the summers of 2013 and 2016; and passive acoustic detections from bottom mounted instruments deployed year round along the 1000-m depth contour from 2012-2020 in U.S. waters (U.S. Navy, NEFSC, SEFSC), and from 2014-2021 in Canadian waters (DFO). Isobaths are the 200-m, 1000-m and 4000-m depth contours. Circle symbols represent shipboard sightings, squares are aerial sightings, open triangles are towed array detections, and filled triangles are detections from bottom mounted passive acoustic instruments. Black symbols represent Gervais' beaked whales, and gray symbols represent passive acoustic detections that are either Gervais' or True's beaked whales.

POPULATION SIZE

The best abundance estimate for Gervais' beaked whales is the sum of the 2021 survey estimates – 8,595 (CV=0.24; Garrison & Aichinger Dias 2023; Palka 2023). This estimate, derived from shipboard surveys, covers most of this stock's known range. In the 2021 survey, improvements to training and field protocols for both visual observers and passive acoustic monitoring of *Mesoplodon* spp. facilitated differentiation of species during many of the encounters. This enabled abundance estimates to be calculated for each beaked whale species individually using the positively identified beaked whale sightings and a portion of the unidentified beaked whale sightings, rather than grouping together all beaked whale sightings to the genus level.

Recent Surveys and Abundance Estimates

Prior to 2021, abundance estimates were of pooled *Mesoplodon* spp. With the improvements to the training and field protocols that allow the reporting of beaked whale species specific sightings, species specific abundance estimates were able to be calculated using standard analysis methods of the visual sightings data. Thus, the estimates of pooled beaked whale species abundances are no longer reported in the stock assessment reports. An abundance estimate of 8,595 (CV=0.24) Gervais' beaked whales was generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2021 (Table 1; Garrison and Aichinger Dias 2023; Palka 2023). One survey was conducted from 16 June to 23 August in waters north of 36ºN latitude and consisted of 5,871 km of on-effort trackline along the shelf break and offshore to the outer edge of the U.S. EEZ (NEFSC and SEFSC 2022). The second vessel survey covered waters from central Florida (25ºN latitude) to approximately 38ºN latitude between the 200-m isobaths and the outer edge of the U.S. EEZ during 12 June–31 August. A total of 5,659 km of trackline was covered (NEFSC and SEFSC 2022). Both surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and Borchers 2004). Mark-recapture distance sampling was used to estimate abundance. Availability bias corrections were made for deep divers (including beaked whales) detected on the shipboard surveys and all species detected on the aerial surveys. Estimates from the two surveys were combined and CVs pooled to produce a species abundance estimate for the stock area.

Table 1. Summary of abundance estimates for Gervais' beaked whales (2021 surveys), month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV). The estimate considered best is in bold font.

Month/Year	Area	N_{best}	CV
Jun–Aug 2021	New Jersey to lower Bay of Fundy	0	0
Jun–Aug 2021	Central Florida to New Jersey	8,595	0.24
Jun–Aug 2021	**Central Florida to lower Bay of Fundy (COMBINED)**	**8,595**	**0.24**

Minimum Population Estimate

The minimum population estimate 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 distribution as specified by Wade and Angliss (1997). The best estimate of abundance of Gervais' beaked whales is 8,595 (CV=0.24). The minimum population estimate for Gervais' beaked whales in U.S. waters of the western North Atlantic is 7,022. Despite not covering Canadian waters, given that the survey effort covered most of the stock range, this estimate is assumed to be range-wide.

Current Population Trend

A trend analysis has not been conducted for this stock. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval. 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). There is current work to standardize the strata-specific previous abundance estimates to consistently represent the same regions and include appropriate corrections for perception and availability bias. These standardized abundance estimates will be used in state-space trend models that incorporate environmental factors that could potentially influence the process and observational errors for each stratum.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. *Mesoplodon europaeus* life history parameters that could be used to estimate net productivity include: estimated mean length at birth of 2.1 m, length at sexual maturity of up to 5.2 m for females and up to 4.6 m for males, and maximum age of 27 dental growth layer groups (GLG's), which are presumed to each correspond to a single year of growth (Mead 1984).

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 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 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 Gervais' beaked whales is 7,022 (Table 2). 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. PBR for Gervais' beaked whales in the western North Atlantic is 70.

Table 2. Best and minimum abundance estimates for Gervais' beaked whales (*Mesoplodon europaeus*) of the Western North Atlantic with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

N_{est}	CV N_{est}	N_{min}	F_r	R_{max}	PBR
8,595	0.24	7,022	0.5	0.04	70

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2018– 2022 total average estimated annual mortality of Gervais' beaked whales in observed fisheries in the U.S. Atlantic EEZ is zero. No information is available on average estimated annual mortality of Gervais' beaked whales from fisheries in Canadian waters. The 2018–2022 total average estimated annual human-caused mortality of Gervais' beaked whales in the U.S. Atlantic EEZ is 0.2 based on one stranded animal killed in 2019 by plastic ingestion (Table 3).

Table 3. Total annual estimated average human-caused mortality and serious injury for the North Atlantic stock of Gervais' beaked whales (*Mesoplodon europaeus*).

Years	Source	Annual Avg.	CV
2018–2022	U.S. fisheries using observer data	0	NA
2018–2022	Possible non-fishery human-caused stranding mortalities	0.2	NA
TOTAL		NA	NA

Fishery Information

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

In 2018–2022, estimated annual average fishery-related mortality or serious injury of this stock in U.S. fisheries was 0 for all beaked whales. Detailed fishery information is reported in Appendix III.

Other Mortality

During 2018–2022, 16 Gervais' beaked whales stranded along the U.S. Atlantic coast (Table 3; NOAA National Marine Mammal Health and Stranding Response Database, accessed 21 November 2023).

*Table 3. Gervais' beaked whale (***Mesoplodon europaeus***) strandings along the U.S. Atlantic coast.*

State	2018	2019	2020	2021	2022	Total
North Carolina	8	1	4	0	0	13
South Carolina	0	0	1	0	0	1
Florida[a]	0	2	0	0	0	2
Total	**8**	**3**	**5**	**0**	**0**	**16**

a. Florida stranding in 2019 deemed human interaction due to plastic ingestion.

STATUS OF STOCK

Gervais' beaked whales are not listed as threatened or endangered under the Endangered Species Act and the western North Atlantic stock of Gervais' beaked whales is currently not considered strategic under the Marine Mammal Protection Act, although there are insufficient data to determine trends in population size. As this species occurs in offshore pelagic waters, the observed mortality likely underestimates the true mortality. The population structure of Gervais' beaked whales in the western North Atlantic is presently unknown; thus, for now, they are considered one stock. The permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality, and no fishery-related mortality and serious injury has been observed during the recent 5-year (2018–2022) period. Therefore, the total U.S. fishery mortality and serious injury rate can be considered to be insignificant and approaching zero. The mortality and/or serious injury of Gervais' beaked whales in non-U.S. fisheries is unknown. The status of Gervais' beaked whales relative to OSP is unknown.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Anthropogenic noise

Anthropogenic noise 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 family of beaked whales is considered to be very sensitive to anthropogenic noise, with several mass strandings documented following naval activities, and sub-lethal responses such as avoidance and cessation of foraging to other sources such as shipboard echosounders, and ultrasonic antifouling devices, and intense ship noise (Aguilar Soto et al. 2006, Cholewiak et al. 2017, Hooker et al. 2019, Trickey et al. 2022). 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.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with naval activities (D'Amico et al. 2009; Filadelfo et al. 2009). During the mid- to late 1980's multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whale and Blainville's beaked whales occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 was associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998; A'Amico et al. 2009; Filadelfo et al. 2009). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001; NMFS 2001; Cox et al. 2006). Four Cuvier's, 2 Blainville's, and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsy of 6 dead beaked whales revealed evidence of tissue damage associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Cox et al. 2006).

Fourteen beaked whales (mostly Cuvier's beaked whales but also including Gervais' and Blainville's beaked whales) stranded in the Canary Islands in 2002 (Cox et al. 2006, Fernandez et al. 2005; Martin et al. 2004). Gas bubble-associated lesions and fat embolism were found in necropsied animals from this event, leading researchers to link nitrogen supersaturation with sonar exposure (Fernandez et al. 2005).

Habitat Issues

Changes in spatial distribution and abundance, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Head et al. 2010; Pinsky et al. 2013; Poloczanska et al. 2013; Hare et al. 2016; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat factors. Results varied by season and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys during 2010 to 2017. There is uncertainty in how, if at all, the changes in distribution and population size of cetacean species may interact with changes in distribution of prey species and how the ecological shifts will affect human impacts to the species.

The chronic impacts of contaminants (polychlorinated biphenyls [PCBs] and chlorinated pesticides [DDT, DDE, dieldrin, etc.]) on marine mammal reproduction and health are of concern (e.g., Pierce et al. 2008; Jepson et al. 2016; Hall et al. 2018; Murphy et al. 2018), but research on contaminant levels for the western north Atlantic beaked whales is lacking.

REFERENCES CITED

Aguilar Soto, N., Johnson, M., Madsen, P.T., Tyack, P.L., Bocconcelli, A. and Fabrizio Borsani, J., 2006. Does intense ship noise disrupt foraging in deep-diving Cuvier's beaked whales (Ziphius cavirostris)?. Marine Mammal Science, 22(3), pp.690-699.

Balcomb, K.C.I. and D.E. Claridge 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. 2: 2-12.

Barlow, J., M.C. Ferguson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka and G. Waring 2006. Abundance and densities of beaked and bottlenose whales (family *Ziphiidae*). J. Cetacean Res. Manage. 7: 263-270.

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.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press. 432 pp.

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.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580. doi: 10.3389/fmars.2022.877580

Cholewiak, D., DeAngelis, A.I., Palka, D., Corkeron, P.J. and Van Parijs, S.M., 2017. Beaked whales demonstrate a marked acoustic response to the use of shipboard echosounders. Royal Society open science, 4(12), p.170940.

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S., Wiggins, S.M., Rafter, M.A., Baggett, L.M. and Hildebrand, J.A., 2022. Identification of western North Atlantic odontocete echolocation click types using machine learning and spatiotemporal correlates. PloS one, 17(3), p.e0264988.

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S. and Hildebrand, J.A., 2023. Spatial and temporal separation of toothed whales in the western North Atlantic. Marine Ecology Progress Series, 720, pp.1-24.Cox, T.M., T.J. Ragen, A.J. Read, E. Vos, R.W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G.D. Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hilderbrand, D. Houser, T. Hullar, P.D. Jepson, D. Ketten, C.D. MacLeod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead and L. Benner 2006. Understanding the impacts of anthropogenic sound on beaked whales. J. Cetacean Res. Manage. 7(3): 177-187.

D'Amico, A., Gisiner, R.C., Ketten, D.R., Hammock, J.A., Johnson, C., Tyack, P.L., and J. Mead. 2009. Beaked whale strandings and naval exercises. Aquatic Mammals 35(4) 452-472.

DeAngelis, A.I., Stanistreet, J.E., Baumann-Pickering, S. and Cholewiak, D.M., 2018. A description of echolocation clicks recorded in the presence of True's beaked whale (Mesoplodon mirus). The Journal of the Acoustical Society of America, 144(5), pp.2691-2700.

DeAngelis, A. I., Westell, A., Corkeron, P., Solsona Berga, A., Trickey, J., Rafter, M., Baumann-Pickering, S., Cholewiak, D., Soldevilla, M., Bell, J., Van Parijs, S. In review. Niche partitioning of beaked whales (family Ziphiidae) during the summer in the western North Atlantic. Submitted to Marine Ecology Progress Series.

Delarue, J.J., Moors-Murphy, H., Kowarski, K.A., Maxner, E.E., Davis, G.E., Stanistreet, J., Martin, S.B., 2024. Acoustic occurrence of beaked whales off eastern Canada, 2015-2017. Endangered Species Research 53: 439-466. https://doi.org/10.3354/esr01314.

Fernandez, A., J.F. Edwards, F. Rodriguez, A.E. de los Monteros, P. Herraez, P. Castro, J.R. Jaber, V. Martin, and M. Arbelo 2005. "Gas and Fat Embolic Syndrome" involving a mass stranding of beaked whales (Family *Ziphiidae*) exposed to anthropogenic sonar signals. Veterinary Pathology 42(4):446-457.

Filadelfo, R., Mintz, J., Michlovich, E., D'Amico, A., Tyack, P.L., and D.R. Ketten. 2009. Correlating military sonar use with beaked whale mass strandings: What do the historical data show? Aquatic mammals 35(4) 435-444.

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392: 29.

Garrison, L.P. 2020. Abundance of cetaceans along the southeast U.S. east coast from a summer 2016 vessel survey. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRD Contribution # PRD-2020-04, 17 pp.

Garrison, L.P. and L.A. Dias. 2023. Abundance of marine mammals in waters of the southeastern U.S. Atlantic during summer 2021. SEFSC MMTD Contribution: #MMTD-2023-01. 23 pp. https://repository.library.noaa.gov/view/noaa/49152

Grieve, B.D., J.A. Hare and V.S. Saba. 2017. Projecting the effects of climate change on *Calanus finmarchicus* distribution within the US Northeast continental shelf. Sci. Rep. 7:6264.

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.

Hare, J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, A.S. Chute, K.L. Curti, T.H. Curtis, D. Kurcheis, J.F. Kocik, S.M. Lucey, C.T. McCandless, L.M. Milke, D.E. Richardson, E. Robillard, H.J. Walsh, M.C. McManus, K.E. Maranick and C.A. Griswold. 2016. A vulnerability assessment of fish and invertebrates to climate change on the Northeast U.S. continental shelf, PLoS ONE 11:e0146756. https://doi.org/10.1371/journal.pone.0146756.s014.

Hall, A.J., B.J. McConnell, L.J. Schwacke, G.M. Ylitalo, R. Williams and T.K. Rowles. 2018. Predicting the effects of polychlorinated biphenyls on cetacean populations through impacts on immunity and calf survival. Environ. Poll. 233:407–418.

Head, E.J.H., and P. Pepin. 2010. Spatial and inter-decadal variability in plankton abundance and composition in the Northwest Atlantic (1958–2006). J. Plankton Res. 32:1633–1648.

Hooker, S.K., De Soto, N.A., Baird, R.W., Carroll, E.L., Claridge, D., Feyrer, L., Miller, P.J., Onoufriou, A., Schorr, G., Siegal, E. and Whitehead, H., 2019. Future directions in research on beaked whales. Frontiers in marine Science, 5, p.514.

Jefferson, T.A., M.A. Webber and R.L. Pitman. 2008. Marine mammals of the world. Elsevier, Amsterdam Netherlands. 573 pp.

Jepson, P.D., R. Deaville, J.L. Barber, A. Aguilar, A. Borrell, S. Murphy, J. Barry, A. Brownlow, J. Barnett, S. Berrow and A.A. Cunningham. 2016. PCB pollution continues to impact populations of orcas and other dolphins in European waters. Sci. Rep.-U.K. 6:18573.

Kowarski, K.A., Martin, S.B., Maxner, E.E., Lawrence, C.B., Delarue, J.J.Y. and Miksis-Olds, J.L., 2023. Cetacean acoustic occurrence on the US Atlantic Outer Continental Shelf from 2017 to 2020. Marine Mammal Science, 39(1), pp.175-199.

Laake, J. L., and D. L. Borchers. 2004. Methods for incomplete detection at distance zero. Pages 108–189 *in*: S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.), Advanced distance sampling. Oxford University Press, New York, New York.Leatherwood, S., D.K. Caldwell and H.E. Winn 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. NOAA Tech. Rep. NMFS Circ. 396. 176 pp.

Lucas, Z. N. and S. K. Hooker 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114(1): 46-61.

MacLeod, C., WF. Perrin, R. Pitman, J. Barlow, L. Ballance, A. D'Amico, T. Gerrodette, G. Joyce, K.D. Mullin, D.L. Palka and G.T. Waring 2006. Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). J. Cetacean Res. Manage. 7(3): 271–286.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. Endang. Species Res. 7:125–136.

Martín, V., A. Servidio, and S. García 2004. Mass strandings of beaked whales in the Canary Islands. ECS Newsletter 42:33-6.

Mead, J.G. 1984. Survey of reproductive data for the beaked whales (*Ziphiidae*). Rep. Int. Whal. Comm. (Special Issue) 6: 91-96.

Mead, J.G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430 *in*: S.H. Ridgway and R. Harrison, (eds.) Handbook of marine mammals, Vol. 4: River Dolphins and toothed whales. Academic press, San Diego.

Moore, M.J., B. Rubinstein, T.P. Lipscomb and S. Norman. 2005. The most northerly record of Gervais' beaked whale, *Mesoplodon europeaus*, from the Western Atlantic. J. Cetacean Res. Manage. 6**:** 279-281.

Morley, J.W., R.L. Selden, R.J. Latour, T.L. Frolicher, R.J. Seagraves and M.L. Pinsky. 2018. Projecting shifts in thermal habitat for 686 species on the North American continental shelf. PLoS ONE 13(5):e0196127.

Murphy, S., R.J. Law, R. Deaville, J.Barnett, M W. Perkins, A. Brownlow, R. Penrose, N.J. Davison, J.L. Barber P.D. Jepson. 2018. Organochlorine contaminants and reproductive implication in cetaceans: A case study of the common dolphin. Pages 3–38 *in* M.C. Fossi and C. Panti, (eds.) Marine mammal ecotoxicology:Impacts of multiple stressors on population health. Academic Press, New York, New York.

NMFS 2001. Joint interim report on the Bahamas marine mammal stranding event of 15-16 March 2000 (December 2001). NOAA unpublished report 55 pp. https://repository.library.noaa.gov/view/noaa/16198

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.

Nye, J., J. Link, J. Hare and W. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Mar. Ecol. Prog. Ser. 393:111–129.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. https://repository.library.noaa.gov/view/noaa/5258

Palka, D. 2020. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2016 line transect surveys conducted by the Northeast Fisheries Science Center. Northeast Fish. Sci. Cent. Ref. Doc. 20-05.

Palka, D.L. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. Northeast Fish. Sci. Cent. Ref. Doc. 12-29. 37 pp. https://repository.library.noaa.gov/view/noaa/4312

Palka, DL. 2023. Cetacean abundance in the US Northwestern Atlantic Ocean, Summer 2021. Northeast Fish. Sci. Cent. Ref. Doc. 23-08.

Pierce, G.J. M.B. Santos, S. Murphy, J.A. Learmonth, A.F. Zuur, E. Rogan, P. Bustamante, F. Caurant, V. Lahaye, V. Ridoux, B.N. Zegers, A. Mets, M. Addink, C. Smeenk, T. Jauniaux, R.J. Law, W. Dabin, A. López, J.M. Alonso Farré, A.F. González, A. Guerra, M. García-Hartmann, R.J. Reid, C.F. Moffat, C. Lockyer, J.P. Boon. 2008. Bioaccumulation of persistent organic pollutants in female common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*) from western European seas: Geographical trends, causal factors and effects on reproduction and mortality. Environmental Pollution. 153:401–415.

Pinsky, M.L., B. Worm, M.J. Fogarty, J.L. Sarmiento and S.A. Levin. 2013. Marine taxa track local climate velocities. Science 341:1239–1242.

Poloczanska, E.S., C.J. Brown, W.J. Sydeman, W. Kiessling, D.S. Schoeman, P.J. Moore, K. Brander, J.F. Bruno, L.B. Buckley, M.T. Burrows, C.M. Duarte, B.S. Halpern, J. Holding, C.V. Kappel, M.I. O'Connor, J.M. Pandolfi, C. Parmesan, F. Schwing, S.A. Thompson and A.J. Richardson. 2013. Global imprint of climate change on marine life. Nat. Clim. Change 3:919–925.

Simmonds, M.P. and L.F. Lopez-Jurado 1991. Whales and the military. Nature: 351:448.

Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.

Stanistreet, J.E., Nowacek, D.P., Baumann-Pickering, S., Bell, J.T., Cholewiak, D.M., Hildebrand, J.A., Hodge, L.E., Moors-Murphy, H.B., Van Parijs, S.M. and Read, A.J., 2017. Using passive acoustic monitoring to document the distribution of beaked whale species in the western North Atlantic Ocean. Canadian Journal of Fisheries and Aquatic Sciences, 74(12), pp.2098-2109.

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(1): 157-175.

Thomas L, J.L. Laake, E. Rexstad, S. Strindberg, F.F.C. Marques, S.T. Buckland, D.L. Borchers, D.R. Anderson, K.P. Burnham, M.L. Burt, S.L. Hedley, J.H. Pollard, J.R.B. Bishop and T.A. Marques. 2009. Distance 6.0. Release 2. [Internet]. University of St. Andrews (UK): Research Unit for Wildlife Population Assessment. Available from: http://distancesampling.org/Distance/

Tove, M. 1995. Live sighting of *Mesoplodon CF. M. Mirus*, True's Beaked Whale. Mar. Mamm. Sci. 11(1): 80-85.

Trickey, J.S., Cárdenas-Hinojosa, G., Rojas-Bracho, L., Schorr, G.S., Rone, B.K., Hidalgo-Pla, E., Rice, A. and Baumann-Pickering, S., 2022. Ultrasonic antifouling devices negatively impact Cuvier's beaked whales near Guadalupe Island, México. Communications Biology, 5(1), p.1005.

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. Available from: https://repository.library.noaa.gov/view/noaa/15963

SOWERBY'S BEAKED WHALE (*Mesoplodon bidens*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sowerby's beaked whales represent a transboundary stock that occurs year-round from Norfolk, VA to Orphan Basin off Newfoundland, though they have also been acoustically detected as far south as Cape Hatteras, NC (Leatherwood et al. 1976; Mead 1989; MacLeod et al. 2006; Jefferson et al. 2008, Stanistreet et al. 2017, Cohen et al. 2022, 2023, Delarue et al. 2024, Feyrer et al. 2024, DeAngelis et al. *in review*) (Figure 1), and a single stranding occurred off the Florida west coast (Dix et al. 1986, Bonde & O'Shea 1989, Mead 1989) but is considered to be an extralimital record. Using year-round passive acoustic monitoring, Sowerby's beaked whales in U.S. waters have two concentrations, one off the Mid-Atlantic shelf break in the fall and summer, and the other off of Georges Bank in the early spring, though they are also detected year-round (Stanistreet et al. 2017, Cohen et al. 2022, 2023, Feyrer et al. 2024). In Canadian waters, there are several concentrations, mainly around the Fundian Channel, but also at the Gully, the southern Grand Banks, and the Sackville Spur off Newfoundland (Delarue et al. 2024, Feyrer et al. 2024). Unlike the other beaked whale species in the western North Atlantic, Sowerby's beaked whales are not uncommon in shallower shelf break waters (< 500 m), especially in the Fundian and Laurentian Channels, and the Cabot Strait (Delarue et al. 2024, Feyrer et al. 2024, DeAngelis et al. *in review*), though they have been occasionally detected and sighted in deep abyssal waters (Palka et al. 2012, DeAngelis et al. *in review*, Figure 1).

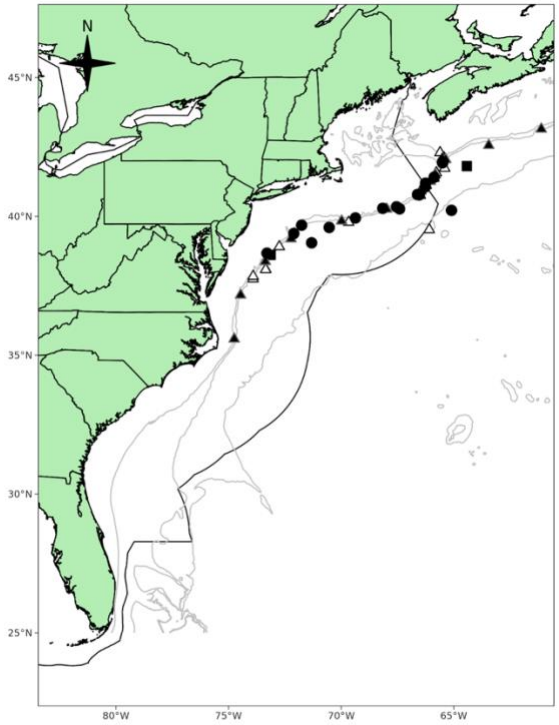


Figure 1: Visual sightings and passive acoustic detections of Sowerby's beaked whale using sightings rom NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006- 2008, 2010, 2011, 2016, and 2021; and DFO's 2007 TNASS and 2016 NAISS surveys; passive acoustic detections from NEFSC shipboard surveys during the summers of 2013-2019, 2021, and spring of 2014, and SEFSC shipboard surveys during the summers of 2013 and 2016; and passive acoustic detections from bottom mounted instruments deployed year round along the 1000-m depth contour from 2012-2020 in U.S. waters (U.S. Navy, NEFSC, SEFSC), and from 2014-2021 in Canadian waters (DFO). Isobaths are the 200-m, 1000-m and 4000-m depth contours. Circle symbols represent shipboard sightings, squares are aerial sightings, open triangles are towed array detections, and filled triangles are detections from bottom mounted passive acoustic instruments.

This species is considered "at risk" in Canadian waters and has been designated as "Special Concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2019) due to their vulnerability to anthropogenic threats (Feyrer et al. in press). Whitehead (2013) reports that in the 23 years of cetacean observations in the Gully Marine Protected Area, on the edge of the Scotian Shelf, Nova Scotia, Canada, they have observed a significant increase in sightings of Sowerby's beaked whales.

POPULATION SIZE

The best abundance estimate for Sowerby's beaked whales is the sum of the 2021 survey estimates–492 (CV=0.50). This estimate, derived from shipboard surveys, covers most of this stock's known range. In the 2021 survey, improvements to field protocols for both visual observers and passive acoustic monitoring of *Mesoplodon* spp. facilitated differentiation of species during encounters. This enabled abundance estimates to be calculated for each species individually rather than grouping together at the genus level.

Recent Surveys and Abundance Estimates

Prior to 2021, abundance estimates were of pooled Mesoplodon spp. With the improvements to the field protocols allowing the reporting of beaked whale species specific abundance estimates, the estimates of pooled species abundances are no longer reported in the stock assessment reports. An abundance estimate of 492 (CV=0.50) Sowerby's beaked whales was generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2021 (Table 1; Garrison and Dias 2023; Palka 2023). One survey was conducted from 16 June to 23 August in waters north of 36ºN latitude and consisted of 5,871 km of on-effort trackline along the shelf break and offshore to the outer edge of the U.S. EEZ (NEFSC and SEFSC 2022). The second vessel survey covered waters from central Florida (25ºN latitude) to approximately 38ºN latitude between the 200-m isobaths and the outer edge of the U.S. EEZ during 12 June–31 August. A total of 5,659 km of trackline was covered on effort (NEFSC and SEFSC 2022). Both surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and Borchers 2004). Mark-recapture distance sampling was used to estimate abundance. Estimates from the two surveys were combined and CVs pooled to produce a species abundance estimate for the stock area.

Table 1. Summary of abundance estimates for Sowerby's beaked whales (2021 surveys), month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Jun–Aug 2021	New Jersey to lower Bay of Fundy (*M. bidens* only)	492	0.50
Jun–Aug 2021	Central Florida to New Jersey (*M. bidens* only)	0	0
Jun–Aug 2021	**Central Florida to lower Bay of Fundy (COMBINED, *M. bidens* only)**	**492**	**0.50**

Minimum Population Estimate

The minimum population estimate 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 distribution as specified by Wade and Angliss (1997). The best estimate of abundance for transboundary stock of Sowerby's beaked whales is 492 (CV=0.50). The minimum population estimate for Sowerby's beaked whales in U.S. waters of the western North Atlantic is 340 (Table 2).

Current Population Trend

There are insufficient data to determine population trends for this stock. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval. 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). There is current work to standardize the strata-specific previous abundance estimates to consistently represent the same regions and include appropriate corrections for perception and availability bias. These standardized abundance estimates will be used in state-space trend models that incorporate environmental factors that could potentially influence the process and observational errors for each stratum.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. *Mesoplodon bidens* life history parameters that could be used to estimate net productivity include: length at birth of up to 2.4 m and maximum length of 5 m for females and 5.5 m for males (Mead 1984).

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 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 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 Sowerby's beaked whales is 492. 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. PBR for Sowerby's beaked whales in the western North Atlantic is 3.4.

Table 2. Best and minimum abundance estimates for Sowerby's beaked whales (*Mesoplodon bidens*) of the Western North Atlantic with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

N_{est}	CV N_{est}	N_{min}	F_r	R_{max}	PBR
492	0.50	340	0.5	0.04	3.4

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2018-2022 total average estimated annual mortality of Sowerby's beaked whales in observed fisheries in the U.S. Atlantic EEZ is zero. Strandings of Sowerby's beaked whales have been reported with injuries pertaining to vessel strikes and entanglement in Canadian waters (COSEWIC 2019). As this species is found deep offshore, these reports coming from stranded animals most likely underrepresent the number of human interactions.

Fishery Information

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

In 2018-2022, estimated annual average fishery-related mortality or serious injury of this stock in U.S. fisheries was 0 for all beaked whales. Detailed fishery information is reported in Appendix III.

Earlier Interactions

See Appendix V for more information on historical takes.

Other Mortality

During 2018–2022 1 Sowerby's beaked whale stranded along the U.S. Atlantic coast without evidence of human interaction (Table 3; NOAA National Marine Mammal Health and Stranding Response Database, accessed 15 October 2022).

Table 3. Sowerby's beaked whale (*Mesoplodon bidens*) strandings along the U.S. Atlantic coast.

State	2018	2019	2020	2021	2022	Total
Maine	0	0	1	0	0	1
Total	**0**	**0**	**1**	**0**	**0**	**1**

STATUS OF STOCK

While Sowerby's beaked whales are not listed as threatened or endangered under the Endangered Species Act, they have been listed as a species of Special Concern by both COSEWIC and SARA (the Species at Risk Act) in Canada due to concerns about lethal and sub-lethal effects on this species from widespread seismic operations as well as occasional military sonar use off of Canada's East Coast (COSEWIC 2019). The western North Atlantic stock of Sowerby's beaked whale is currently not considered strategic under the Marine Mammal Protection Act, and the population structure is unknown, thus for now they are considered to be one transboundary stock. There are insufficient data to determine the population size or trends. As this species occurs in offshore pelagic waters, the observed mortality likely underestimates the true mortality. The permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality, and no fishery-related mortality and serious injury has been observed during the recent 5-year (2018–2022) period. Therefore, the total U.S. fishery mortality and serious injury rate can be considered to be insignificant and approaching zero. The status of Sowerby's beaked whales relative to OSP is unknown.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Anthropogenic noise

Anthropogenic noise 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 family of beaked whales is considered to be very sensitive to anthropogenic sound, with several mass strandings documented following naval activities, and sub-lethal responses such as avoidance and cessation of foraging to other sources such as shipboard echosounders, and ultrasonic antifouling devices, and intense ship noise (Aguilar Soto et al. 2006, Cholewiak et al. 2017, Hooker et al. 2019, Trickey et al. 2022). 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.

To date no mass stranding of this transboundary stock of Sowerby's beaked whales have been reported in the U.S. However, several unusual mass strandings of beaked whales throughout their worldwide range have been associated with naval activities (D'Amico et al. 2009; Filadelfo et al. 2009). During the mid- to late 1980s multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whale and Blainville's beaked whales occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 were associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998; D'Amico et al. 2009; Filadelfo et al. 2009). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001; NMFS 2001; Cox et al. 2006). Four Cuvier's, 2 Blainville's, and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsy of 6 dead beaked whales revealed evidence of tissue damage associated with an acoustic or impulse injury that likely caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Cox et al. 2006).

Fourteen beaked whales (mostly Cuvier's beaked whales but also including Gervais' and Blainville's beaked whales) stranded in the Canary Islands in 2002 (Cox et al. 2006, Fernandez et al. 2005; Martin et al. 2004). Gas bubble-associated lesions and fat embolism were found in necropsied animals from this event, leading researchers to link nitrogen supersaturation with sonar exposure (Fernandez et al. 2005).

Habitat Issues

Changes in spatial distribution and abundance, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Head et al. 2010; Pinsky et al. 2013; Poloczanska et al. 2013; Hare et al. 2016; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat/climatic factors. Results varied by season and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys during 2010 to 2017. There is uncertainty in how, if at all, the changes in distribution and population size of cetacean species may interact with changes in distribution of prey species and how the ecological shifts will affect human impacts to the species.

The chronic impacts of contaminants (polychlorinated biphenyls [PCBs] and chlorinated pesticides [DDT, DDE, dieldrin, etc.]) on marine mammal reproduction and health are of concern (e.g., Pierce et al. 2008; Jepson et al. 2016; Hall et al. 2018; Murphy et al. 2018), but research on contaminant levels for the western north Atlantic beaked whales is currently lacking.

REFERENCES CITED

Aguilar Soto, N., Johnson, M., Madsen, P.T., Tyack, P.L., Bocconcelli, A., Fabrizio Borsani, J. 2006. Does intense ship noise disrupt foraging in deep-diving Cuvier's beaked whales (*Ziphius cavirostris*)?. Marine Mammal Science, 22(3):690-699.

Balcomb, K.C.I. and D.E. Claridge. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. 2: 2-12.

Barlow, J., M.C. Ferguson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka and G. Waring. 2006. Abundance and densities of beaked and bottlenose whales (family *Ziphiidae*). J. Cetacean Res. Manage. 7: 263-270.

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.

Bonde and O'Shea. 1989. Sowerby's beaked whale (*Mesoplodon bidens*) in the Gulf of Mexico. J. Mamm. 70(2):447-449.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press. 432 pp.

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.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf, final report, Cetacean and Turtle Assessment Program, University of Rhode Island. Washington, DC, Bureau of Land Management. #AA551-CT8-48**:** 576.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580. doi: 10.3389/fmars.2022.877580

Cholewiak, D., S. Baumann-Pickering and S. Van Parijs. 2013. Description of sounds associated with Sowerby's beaked whales (*Mesoplodon bidens*) in the western North Atlantic Ocean. J. Acoust. Soc. Am. 134 (5)3905-3912.

Cholewiak, D., DeAngelis, A.I., Palka, D., Corkeron, P.J. and Van Parijs, S.M., 2017. Beaked whales demonstrate a marked acoustic response to the use of shipboard echosounders. Royal Society open science, 4(12), p.170940.

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S., Wiggins, S.M., Rafter, M.A., Baggett, L.M. and Hildebrand, J.A., 2022. Identification of western North Atlantic odontocete echolocation click types using machine learning and spatiotemporal correlates. PloS one, 17(3), p.e0264988.

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S. and Hildebrand, J.A., 2023. Spatial and temporal separation of toothed whales in the western North Atlantic. Marine Ecology Progress Series, 720, pp.1-24.

COSEWIC. 2019. COSEWIC Assessment and status report on the Sowerby's beaked whale Mesoplodon bidens in Canada, Committee on the Status of Endangered Wildlife in Canada. Ottawa, xi+ 41 pp. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html.

Cox, T. M., T. J. Ragen, A. J. Read, E. Vos, R. W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D. Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P. D. Jepson, D. Ketten, C. D. MacLeod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead and L. Benner. 2006. Understanding the impacts of anthropogenic sound on beaked whales. J. Cetacean Res. Manage. 7(3): 177-187.

D'Amico, A., R.C. Gisiner, D.R. Ketten, J.A. Hammock, C. Johnson, P.L. Tyack and J. Mead. 2009. Beaked whale strandings and naval exercises. Aq. Mamm. 35(4) 452-472.

DeAngelis, A. I., Westell, A., Corkeron, P., Solsona Berga, A., Trickey, J., Rafter, M., Baumann-Pickering, S., Cholewiak, D., Soldevilla, M., Bell, J., Van Parijs, S. In revision. Niche partitioning of beaked whales (family Ziphiidae) during the summer in the western North Atlantic. Submitted to Marine Ecology Progress Series.

Delarue, J.J., Moors-Murphy, H., Kowarski, K.A., Maxner, E.E., Davis, G.E., Stanistreet, J., Martin, S.B., 2024. Acoustic occurrence of beaked whales off eastern Canada, 2015-2017. Endangered Species Research 53: 439-466. https://doi.org/10.3354/esr01314.

Dix, L., Lein, J., Sergeant, D.E. 1986. A North Sea beaked whale, *Mesoplodan bidens*, in Conception Bay, Newfoundland. Canadian Field-Nat., 100:389-391.

Fernandez, A., J.F. Edwards, F. Rodriguez, A.E. de los Monteros, P. Herraez, P. Castro, J.R. Jaber, V. Martin and M. Arbelo. 2005. "Gas and Fat Embolic Syndrome" involving a mass stranding of beaked whales (Family *Ziphiidae*) exposed to anthropogenic sonar signals. Veterinary Pathology 42(4):446-457.

Feyrer, L.J., Stanistreet, J.E., Gomez, C., Adams, M., Lawson, J., Ferguson, S.H., Heaslip, S.G., LeFort, K., Davidson, E., Hussey, N., Whitehead, H., and Moors-Murphy, H. 2024. Identifying important habitat for northern bottlenose and Sowerby's beaked whales in the western North Atlantic. Aquatic Conservation: Marine and Freshwater Ecosystems 34(1): e4064.

Filadelfo, R., J. Mintz, E. Michlovich, A. D'Amico, P.L. Tyack and D.R. Ketten. 2009. Correlating military sonar use with beaked whale mass strandings: What do the historical data show? Aq. Mamm.35(4) 435-444.

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392: 29.

Garrison, L.P. 2020. Abundance of cetaceans along the southeast U.S. east coast from a summer 2016 vessel survey. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRD Contribution # PRD-2020-04, 17 pp.

Garrison, L.P. and L.A. Dias. 2023. Abundance of marine mammals in waters of the southeastern U.S. Atlantic during summer 2021. SEFSC MMTD Contribution: #MMTD-2023-01. 23 pp. https://repository.library.noaa.gov/view/noaa/49152

Grieve, B.D., Hare, J.A.,Saba, V.S. 2017. Projecting the effects of climate change on *Calanus finmarchicus* distribution within the US Northeast continental shelf. Sci. Rep. 7:6264.

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.

Hare, J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, A.S. Chute, K.L. Curti, T.H. Curtis, D. Kurcheis, J.F. Kocik, S.M. Lucey, C.T. McCandless, L.M. Milke, D.E. Richardson, E. Robillard, H.J. Walsh, M.C. McManus, K.E. Maranick and C.A. Griswold. 2016. A vulnerability assessment of fish and invertebrates to climate change on the Northeast U.S. continental shelf, PLoS ONE 11:e0146756. https://doi.org/10.1371/journal.pone.0146756.s014.

Hall, A.J., B.J. McConnell, L.J. Schwacke, G.M. Ylitalo, R. Williams T.K. Rowles. 2018. Predicting the effects of polychlorinated biphenyls on cetacean populations through impacts on immunity and calf survival. Environ. Poll. 233:407–418.

Head, E.J.H.,Pepin, P 2010. Spatial and inter-decadal variability in plankton abundance and composition in the Northwest Atlantic (1958–2006). J. Plankton Res. 32:1633–1648.

Hooker, S.K., De Soto, N.A., Baird, R.W., Carroll, E.L., Claridge, D., Feyrer, L., Miller, P.J., Onoufriou, A., Schorr, G., Siegal, E., Whitehead, H. 2019. Future directions in research on beaked whales. Frontiers in marine Science, 5, p.514.

Jefferson, T.A., M.A. Webber, and R.L. Pitman 2008. Marine Mammals of the World. Elsevier, Amsterdam, Netherlands. 573 pp.

Jepson, P.D., R. Deaville, J.L. Barber, A. Aguilar, A. Borrell, S. Murphy, J. Barry, A. Brownlow, J. Barnett, S. Berrow and A.A. Cunningham. 2016. PCB pollution continues to impact populations of orcas and other dolphins in European waters. Sci. Rep.-U.K. 6:18573.

Laake, J. L., and D. L. Borchers. 2004. Methods for incomplete detection at distance zero. Pages 108–189 *in*: S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.), Advanced distance sampling. Oxford University Press, New York, New York.Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. NOAA Tech. Rep. NMFS Circ. 396. 176 pp.

Lien, J., F. Barry, K. Breeck and U. Zuschlag. 1990. Status of Sowerby's Beaked Whale, *Mesoplodon bidens*, in Canada. Can. Field-Nat. 104(1): 125-130.

Lucas, Z. N. and S. K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114(1): 46-61.

MacLeod, C., W.F. Perrin, R. Pitman, J. Barlow, L. Ballance, A. D'Amico, T. Gerrodette, G. Joyce, K.D. Mullin, D.L. Palka and G.T. Waring. 2006. Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). J. Cetacean Res. Manage. 7(3): 271–286.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. Endang. Species Res. 7:125–136.

Martín, V., A. Servidio and S. García 2004. Mass strandings of beaked whales in the Canary Islands. ECS Newsletter 42:33-6.

Mead, J. G. 1984. Survey of reproductive data for the beaked whales (*Ziphiidae*). Rep. Int. Whal. Comm. (Special Issue) 6: 91-96.
Mead, J. G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430 *in*: S.H. Ridgway and R. Harrison, (eds.) Handbook of marine mammals, Vol. 4: River Dolphins and toothed whales. Academic press, San Diego.
Morley, J.W., R.L. Selden, R.J. Latour, T.L. Frolicher, R.J. Seagraves and M.L. Pinsky. 2018. Projecting shifts in thermal habitat for 686 species on the North American continental shelf. PLoS ONE 13(5):e0196127.
Murphy, S., R.J. Law, R. Deaville, J.Barnett, M W. Perkins, A. Brownlow, R. Penrose, N.J. Davison, J.L. Barber P.D. Jepson. 2018. Organochlorine contaminants and reproductive implication in cetaceans: A case study of the common dolphin. Pages 3–38 *in* M.C. Fossi and C. Panti, (eds.) Marine mammal ecotoxicology:Impacts of multiple stressors on population health. Academic Press, New York, New York.
NMFS 2001. Joint interim report on the Bahamas marine mammal stranding event of 15-16 March 2000 (December 2001). NOAA unpublished report 55 pp. https://repository.library.noaa.gov/view/noaa/16198
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. 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.
Nye, J., J. Link, J. Hare and W. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Mar. Ecol. Prog. Ser. 393:111–129.
Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. https://repository.library.noaa.gov/view/noaa/5258
Palka, D. 2020. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2016 line transect surveys conducted by the Northeast Fisheries Science Center. Northeast Fish. Sci. Cent. Ref. Doc. 20-05.
Palka, D.L. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. Northeast Fish. Sci. Cent. Ref. Doc. 12-29. 37 pp. https://repository.library.noaa.gov/view/noaa/4312
Palka, DL. 2023. Cetacean abundance in the US Northwestern Atlantic Ocean, Summer 2021. Northeast Fish. Sci. Cent. Ref. Doc. 23-08.
Pierce, G.J. M.B. Santos, S. Murphy, J.A. Learmonth, A.F. Zuur, E. Rogan, P. Bustamante, F. Caurant, V. Lahaye, V. Ridoux, B.N. Zegers, A. Mets, M. Addink, C. Smeenk, T. Jauniaux, R.J. Law, W. Dabin, A. López, J.M. Alonso Farré, A.F. González, A. Guerra, M. García-Hartmann, R.J. Reid, C.F. Moffat, C. Lockyer, J.P. Boon. 2008. Bioaccumulation of persistent organic pollutants in female common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*) from western European seas: Geographical trends, causal factors and effects on reproduction and mortality. Environmental Pollution. 153:401–415.
Pinsky, M.L., B. Worm, M.J. Fogarty, J.L. Sarmiento and S.A. Levin. 2013. Marine taxa track local climate velocities. Science 341:1239–1242.
Poloczanska, E.S., C.J. Brown, W.J. Sydeman, W. Kiessling, D.S. Schoeman, P.J. Moore, K. Brander, J.F. Bruno, L.B. Buckley, M.T. Burrows, C.M. Duarte, B.S. Halpern, J. Holding, C.V. Kappel, M.I. O'Connor, J.M. Pandolfi, C. Parmesan, F. Schwing, S.A. Thompson and A.J. Richardson. 2013. Global imprint of climate change on marine life. Nat. Clim. Change 3:919–925.
Richardson, W.J., C.R. Greene Jr, C.I. Malme, and D.H.Thomson 1995 Marine Mammals and Noise, Academic Press, San Diego, CA. 576 pp.
Simmonds, M.P. and L.F. Lopez-Jurado. 1991. Whales and the military. Nature: 351:448.
Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.
Stanistreet, J.E., Nowacek, D.P., Baumann-Pickering, S., Bell, J.T., Cholewiak, D.M., Hildebrand, J.A., Hodge, L.E., Moors-Murphy, H.B., Van Parijs, S.M., Read, A.J. 2017. Using passive acoustic monitoring to document the distribution of beaked whale species in the western North Atlantic Ocean. Canadian Journal of Fisheries and Aquatic Sciences, 74(12), pp.2098-2109.
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(1): 157-175.
Thomas L, J.L. Laake, E. Rexstad, S. Strindberg, F.F.C. Marques, S.T. Buckland, D.L. Borchers, D.R. Anderson, K.P. Burnham, M.L. Burt, S.L. Hedley, J.H. Pollard, J.R.B. Bishop and T.A. Marques. 2009. Distance 6.0. Release

2. [Internet]. University of St. Andrews (UK): Research Unit for Wildlife Population Assessment. Available from: http://distancesampling.org/Distance/.

Tove, M. 1995. Live sighting of *Mesoplodon CF. M. Mirus*, True's Beaked Whale. Mar. Mamm. Sci. 11(1): 80-85.

Trickey, J.S., Cárdenas-Hinojosa, G., Rojas-Bracho, L., Schorr, G.S., Rone, B.K., Hidalgo-Pla, E., Rice, A., Baumann-Pickering, S. 2022. Ultrasonic antifouling devices negatively impact Cuvier's beaked whales near Guadalupe Island, México. Communications Biology, 5(1), p.1005.

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. Available from: https://repository.library.noaa.gov/view/noaa/15963

Wenzel, F.W., P.T. Polloni, J.E. Craddock, D.P. Gannon, J.R. Nicolas, A.J. Read, P.E. Rosel. 2013. Food habits of Sowerby's beaked whales, *Mesoplodon bidens*, taken in the western North Atlantic pelagic drift gillnet fishery. Fish. Bul. 111(4):381-389.

Whitehead, H. 2013. Trends in cetacean abundance in the Gully submarine canyon, 1988–2011, highlight a 21% per year increase in Sowerby's beaked whales (*Mesoplodon bidens*) . Can. J. Zool., 2013, 91(3):141-148.

TRUE'S BEAKED WHALE (*Mesoplodon mirus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

True's beaked whales are a deep-water species that inhabit warm temperate or temperate waters (Macleod et al. 2006). The family of beaked whales is difficult to visually classify to the species level, especially True's and Gervais' beaked whales, which are often misidentified both visually (Tove 1995, Aguilar de Soto et al. 2017) and prove difficult to distinguish acoustically (DeAngelis et al. 2018). However, due to the increased use of high-definition photography it has been possible to improve training of visual observers. Thus, when an observer is provided with a good look at a beaked whale when viewed through high powered binoculars, it is often possible to distinguish them. Until further Gervais' signals are characterized, some passive acoustic studies use a combined "Gervais'/True's" category if uncertain (Kowarski et al. 2023, Delarue et al. 2024, DeAngelis et al. *in review*). The geographic distribution reported here is primarily based on recordings collected from 2012-2021.

True's beaked whales have been reliably detected from Cape Hatteras to the Scotian Shelf (Cohen et al. 2022, DeAngelis et al. *in review*, Figure 1), and may represent a transboundary stock. Visual shipboard surveys in 2021 sighted them off Georges Bank (NEFSC and SEFSC 2022). They have been detected as far north as The Grand Banks of Newfoundland (Delarue et al. 2024). There are no confirmed detections of True's beaked whales south of Cape Hatteras, though passive acoustic studies report the combined "Gervais'/True's" class, thus they could possibly extend further south than Cape Hatteras (Kowarski et al. 2023). DeAngelis et al. (*in revision)* found that during the summer, True's beaked whales were more likely to occur in deep water (>2000 m) than along the shelf break. There could be some seasonality to their presence from Cape Hatteras to Georges Bank, with more usage of the shelf break areas in the summer and winter (Cohen et al. 2023). No seasonality is reported in Canadian waters (Delarue et al. 2024).

It is unclear whether the Western North Atlantic Stock contains multiple demographically independent populations. Studies of the waters surrounding Bear Seamount identified that the seamount is regularly frequented (summers of 2017-2019) by True's beaked whales, but their overall movement patterns are unknown (NEFSC and SEFSC 2018-2020).

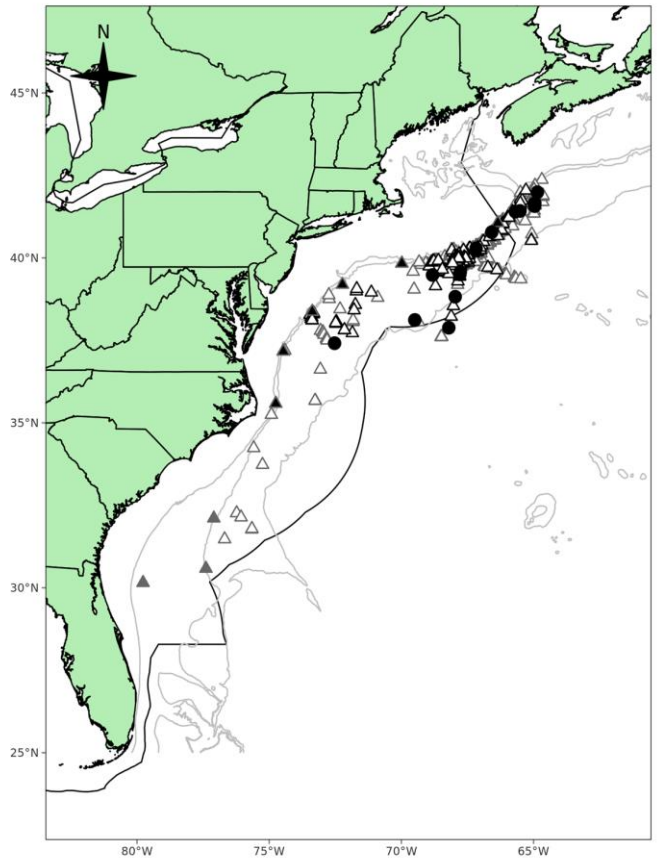


Figure 1: Visual sightings and passive acoustic detections of True's beaked whale (includes* Gervais'/True's passive acoustic detections*) using sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006-2008, 2010, 2011, 2016, and 2021; and DFO's 2007 TNASS and 2016 NAISS surveys; passive acoustic detections from NEFSC shipboard surveys during the summers of 2013-2019, 2021, and spring of 2014, and SEFSC shipboard surveys during the summers of 2013 and 2016; and passive acoustic detections from bottom mounted instruments deployed year round along the 1000-m depth contour from 2012-2020 in U.S. waters (U.S. Navy, NEFSC, SEFSC), and from 2014-2021 in Canadian waters (DFO). Isobaths are the 200-m, 1000-m and 4000-m depth contours. Circle symbols represent shipboard sightings, squares are aerial sightings, open triangles are towed array detections, and filled triangles are detections from bottom mounted passive acoustic instruments. Black symbols represent True's beaked whales, and gray symbols represent passive acoustic detections that are either Gervais' or True's beaked whales.

POPULATION SIZE

The best abundance estimate for True's beaked whales is the sum of the 2021 survey estimates—4,480 (CV=0.34). This estimate, derived from shipboard surveys, covers most of this stock's known range. In the 2021 survey, improvements to field protocols for both visual observers and passive acoustic monitoring of *Mesoplodon* spp. facilitated differentiation of species during encounters. This enabled abundance estimates to be calculated for each beaked whale species individually using the positively identified beaked whale sightings and a portion of the unidentified beaked whale sightings, rather than grouping together all beaked whale species at the genus level.

Recent Surveys and Abundance Estimates

Prior to 2021, abundance estimates were of pooled *Mesoplodon* spp. With the improvements to the field protocols allowing the reporting of beaked whale species specific abundance estimates, the estimates of pooled species abundances are no longer reported in the stock assessment reports. An abundance estimate of 4,480 (CV=0.34) True's beaked whales was generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2021 (Table 1; Garrison and Dias 2023; Palka 2023). One survey was conducted from 16 June to 23 August in waters north of 36ºN latitude and consisted of 5,871 km of on-effort trackline along the shelf break and offshore to the outer edge of the U.S. EEZ (NEFSC and SEFSC 2022). The second vessel survey covered waters from central Florida (25ºN latitude) to approximately 38ºN latitude between the 200-m isobaths and the outer edge of the U.S. EEZ during 12 June–31 August. A total of 5,659 km of trackline was covered on effort (NEFSC and SEFSC 2022). Both surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and Borchers 2004). Mark-recapture distance sampling was used to estimate abundance. Estimates from the two surveys were combined and CVs pooled to produce an abundance estimate for the stock.

Table 1.Summary of abundance estimates for True's beaked whales (2021 surveys), month, year, area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV). The estimate considered best is in bold font.

Month/Year	Area	N_{best}	CV
Jun–Aug 2021	New Jersey to lower Bay of Fundy	4,480	0.34
Jun–Aug 2021	Central Florida to New Jersey	0	0
Jun–Aug 2021	**Central Florida to lower Bay of Fundy (COMBINED)**	**4,480**	**0.34**

Minimum Population Estimate

The minimum population estimate 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 distribution as specified by Wade and Angliss (1997). The best estimate of abundance for True's beaked whales is 4,480 (CV= 0.34). The minimum population estimate for True's beaked whales in the US waters of the western North Atlantic is 3,391.

Current Population Trend

A trend analysis has not been conducted for this stock. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval. 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). There is current work to standardize the strata-specific previous abundance estimates to consistently represent the same regions and include appropriate corrections for perception and availability bias. These standardized abundance estimates will be used in state-space trend models that incorporate environmental factors that could potentially influence the process and observational errors for each stratum.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: length at birth is 2 to 3 m, length at sexual maturity 6.1 m for females, and 5.5 m for males, maximum age for females were 30 expressed in dental growth layer groups (GLG's) which may each correspond to a single year of growth is 30 for and for females and 36 for males (Mead 1984).

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 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 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 True's beaked whales is 3,391. 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. PBR for True's beaked whales in the western North Atlantic is 34.

Table 2. Best and minimum abundance estimates for True's beaked whales (*Mesoplodon mirus*) of the Western North Atlantic with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) and PBR.

N_{est}	CV N_{est}	N_{min}	F_r	R_{max}	PBR
4,480	0.34	3,391	0.5	0.04	34

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2018–2022 total average estimated annual mortality of True's beaked whales in observed fisheries in the U.S. Atlantic EEZ is zero. This minimum value reflects human-caused mortality in U.S. waters only and does not include data from Canada.

Fishery Information

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

In 2017–2021, estimated annual average fishery-related mortality or serious injury of this stock in U.S. fisheries was 0 for all beaked whales. Detailed fishery information is reported in Appendix III.

STATUS OF STOCK

True's beaked whales are not listed as threatened or endangered under the Endangered Species Act, and the western North Atlantic stock is currently not considered strategic under the Marine Mammal Protection Act. As this species occurs in offshore pelagic waters, the observed mortality likely underestimates the true mortality. In addition, the population structure of True's beaked whales in the western North Atlantic is presently unknown, thus, for now, they are considered one stock. There are insufficient data to determine the population trends. The permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality, and no fishery-related mortality and serious injury has been observed during the recent 5-year (2018–2022) period. Therefore, total U.S. fishery-related mortality and serious injury rate can be considered to be insignificant and approaching zero. The mortality and/or serious injury of True's beaked whales in non-U.S. fisheries is unknown. The status of True's beaked whales relative to OSP is unknown.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Anthropogenic noise

Anthropogenic noise 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 family of beaked whales is considered to be very sensitive to anthropogenic noise (Hooker et al. 2019). Several mass strandings have been documented following naval activities, and sub-lethal responses such as avoidance and cessation of foraging, to other sources such as shipboard echosounders, ultrasonic antifouling devices, and intense ship noise (Aguilar de Soto et al. 2006, Cholewiak et al. 2017, Trickey et al. 2022). 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.

Several unusual mass strandings of beaked whales throughout their worldwide range have been associated with naval activities (D'Amico et al. 2009; Filadelfo et al. 2009). During the mid- to late 1980's multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whale and Blainville's beaked whales occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12–13 May 1996 were associated with low-frequency sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998; D'Amico et al. 2009; Filadelfo et al. 2009). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001; NMFS 2001; Cox et al. 2006). Four Cuvier's, 2 Blainville's, and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsy of 6 dead beaked whales revealed evidence of tissue damage associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release;) (Cox et al. 2006).

Fourteen beaked whales (mostly Cuvier's beaked whales but also including Gervais' and Blainville's beaked whales) stranded in the Canary Islands in 2002 (Martin et al. 2004; Fernandez et al. 2005; Cox et al. 2006). Gas bubble-associated lesions and fat embolism were found in necropsied animals from this event, leading researchers to link nitrogen supersaturation with sonar exposure (Fernandez et al. 2005). No True's beaked whales have been identified in these strandings, but these events occurred outside known True's beaked whale range.

Habitat Issues

Changes in spatial distribution and abundance, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Pinsky et al. 2013; Poloczanska et al. 2013; Hare et al. 2016; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat factors. Results varied by season and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys during 2010 to 2017. There is uncertainty in how, if at all, the changes in distribution and population size of cetacean species may interact with changes in distribution of prey species and how the ecological shifts will affect human impacts to the species.

The chronic impacts of contaminants (polychlorinated biphenyls [PCBs] and chlorinated pesticides [DDT, DDE, dieldrin, etc.]) on marine mammal reproduction and health are of concern (e.g., Pierce et al. 2008; Jepson et al. 2016; Hall et al. 2018; Murphy et al. 2018), but research on contaminant levels for the western north Atlantic stock of beaked whales is lacking.

REFERENCES CITED

Aguilar Soto, N., Johnson, M., Madsen, P.T., Tyack, P.L., Bocconcelli, A. and Fabrizio Borsani, J., 2006. Does intense ship noise disrupt foraging in deep-diving Cuvier's beaked whales (*Ziphius cavirostris*)?. Marine Mammal Science, 22(3), pp.690-699.

Balcomb, K.C. III, and D.E. Claridge, 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. 2:2–12.

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.

Barlow, J., M.C. Ferguson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka and G. Waring, 2006. Abundance and densities of beaked and bottlenose whales (family *Ziphiidae*). J. Cetacean Res. Manage. 7:263–270.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, New York, New York. 432 pp.

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.

CETAP 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf, final report #AA551-CT8-48. Cetacean and Turtle Assessment Program, , University of Rhode Island. Bureau of Land Management, Washington, DC. 538 pp.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580. doi: 10.3389/fmars.2022.877580

Cholewiak, D., DeAngelis, A.I., Palka, D., Corkeron, P.J. and Van Parijs, S.M., 2017. Beaked whales demonstrate a marked acoustic response to the use of shipboard echosounders. Royal Society open science, 4(12), p.170940.

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S., Wiggins, S.M., Rafter, M.A., Baggett, L.M. and Hildebrand, J.A., 2022. Identification of western North Atlantic odontocete echolocation click types using machine learning and spatiotemporal correlates. PloS one, 17(3), p.e0264988.

Cohen, R.E., Frasier, K.E., Baumann-Pickering, S. and Hildebrand, J.A., 2023. Spatial and temporal separation of toothed whales in the western North Atlantic. Marine Ecology Progress Series, 720, pp.1-24.

Cox, T.M., T.J. Ragen, A.J. Read, E. Vos, R.W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G.D. Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hilderbrand, D. Houser, T. Hullar, P.D. Jepson, D. Ketten, C.D. MacLeod, P. Miller, S. Moore, D. Moutain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead and L. Benner. 2006. Understanding the impacts of anthropogenic sound on beaked whales. J. Cetacean Res. Manage. 7:177–187.

D'Amico, A., R.C. Gisiner, D.R. Ketten, J.A. Hammock, C. Johnson, P.L Tyack and J. Mead. 2009. Beaked whale strandings and naval exercises. Aq. Mamm. 35:452–472.

DeAngelis, A.I., Stanistreet, J.E., Baumann-Pickering, S. and Cholewiak, D.M., 2018. A description of echolocation clicks recorded in the presence of True's beaked whale (*Mesoplodon mirus*). The Journal of the Acoustical Society of America, 144(5), pp.2691-2700.

DeAngelis, A. I., Westell, A., Corkeron, P., Solsona Berga, A., Trickey, J., Rafter, M., Baumann-Pickering, S., Cholewiak, D., Soldevilla, M., Bell, J., Van Parijs, S. In review. Niche partitioning of beaked whales (family Ziphiidae) during the summer in the western North Atlantic. Submitted to Marine Ecology Progress Series.

Delarue, J.J., Moors-Murphy, H., Kowarski, K.A., Maxner, E.E., Davis, G.E., Stanistreet, J., Martin, S.B., 2024. Acoustic occurrence of beaked whales off eastern Canada, 2015-2017. Endangered Species Research 53: 439-466. https://doi.org/10.3354/esr01314.

Fernandez, A., J.F. Edwards, F. Rodriguez, A.E. de los Monteros, P. Herraez, P. Castro, J.R. Jaber, V. Martin and M. Arbelo. 2005. "Gas and Fat Embolic Syndrome" involving a mass stranding of beaked whales (Family *Ziphiidae*) exposed to anthropogenic sonar signals. Vet. Pathol. 42:446–457.

Filadelfo, R., J. Mintz, E. Michlovich, A. D'Amico, P.L. Tyack and D.R. Ketten. 2009. Correlating military sonar use with beaked whale mass strandings: What do the historical data show? Aq. Mamm. 35:435–444.

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392:29.

Garrison, L.P. 2020. Abundance of cetaceans along the southeast U.S. east coast from a summer 2016 vessel survey. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRD Contribution # PRD-2020-04, 17 pp.

Garrison, L.P. and L.A. Dias. 2023. Abundance of marine mammals in waters of the southeastern U.S. Atlantic during summer 2021. SEFSC MMTD Contribution: #MMTD-2023-01. 23 pp. https://repository.library.noaa.gov/view/noaa/49152

Grieve, B.D., J.A. Hare and V.S. Saba. 2017. Projecting the effects of climate change on *Calanus finmarchicus* distribution within the US Northeast continental shelf. Sci. Rep. 7:6264.

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.

Hare, J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, A.S. Chute, K.L. Curti, T.H. Curtis, D. Kurcheis, J.F. Kocik, S.M. Lucey, C.T. McCandless, L.M. Milke, D.E. Richardson, E. Robillard, H.J. Walsh, M.C. McManus, K.E. Maranick and C.A. Griswold. 2016. A vulnerability assessment of fish and invertebrates to climate change on the Northeast U.S. continental shelf, PLoS ONE 11:e0146756. https://doi.org/10.1371/journal.pone.0146756.s014.

Hall, A.J., B.J. McConnell, L.J. Schwacke, G.M. Ylitalo, R. Williams and T.K. Rowles. 2018. Predicting the effects of polychlorinated biphenyls on cetacean populations through impacts on immunity and calf survival. Environ. Poll. 233:407–418.

Head, E.J.H., and P. Pepin. 2010. Spatial and inter-decadal variability in plankton abundance and composition in the Northwest Atlantic (1958–2006). J. Plankton Res. 32:1633–1648.

Hare, J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, A.S. Chute, K.L. Curti, T.H. Curtis, D. Kurcheis, J.F. Kocik, S.M. Lucey, C.T. McCandless, L.M. Milke, D.E. Richardson, E. Robillard, H.J. Walsh, M.C. McManus, K.E. Maranick and C.A. Griswold. 2016. A vulnerability assessment of fish and invertebrates to climate change on the Northeast U.S. continental shelf, PLoS ONE 11:e0146756. https://doi.org/10.1371/journal.pone.0146756.s014.

Hall, A.J., B.J. McConnell, L.J. Schwacke, G.M. Ylitalo, R. Williams and T.K. Rowles. 2018. Predicting the effects of polychlorinated biphenyls on cetacean populations through impacts on immunity and calf survival. Environ. Poll. 233:407–418.

Head, E.J.H., and P. Pepin. 2010. Spatial and inter-decadal variability in plankton abundance and composition in the Northwest Atlantic (1958–2006). J. Plankton Res. 32:1633–1648.

Hooker, S.K., De Soto, N.A., Baird, R.W., Carroll, E.L., Claridge, D., Feyrer, L., Miller, P.J., Onoufriou, A., Schorr, G., Siegal, E. and Whitehead, H., 2019. Future directions in research on beaked whales. Front. Mar. Sci. 5, p.514.

Jefferson, T.A., M.A. Webber and R.L. Pitman. 2008. Marine mammals of the world. Elsevier, Amsterdam, Netherlands. 573 pp.

Jepson, P.D., R. Deaville, J.L. Barber, A. Aguilar, A. Borrell, S. Murphy, J. Barry, A. Brownlow, J. Barnett, S. Berrow and A.A. Cunningham. 2016. PCB pollution continues to impact populations of orcas and other dolphins in European waters. Sci. Rep.-U.K. 6:18573.

Kowarski, K.A., Martin, S.B., Maxner, E.E., Lawrence, C.B., Delarue, J.J.Y. and Miksis-Olds, J.L., 2023. Cetacean acoustic occurrence on the US Atlantic Outer Continental Shelf from 2017 to 2020. Mar. Mamm. Sci., 39(1), pp.175-199.

Laake, J. L., and D. L. Borchers. 2004. Methods for incomplete detection at distance zero. Pages 108-189 *in*: S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.), Advanced distance sampling. Oxford University Press, New York, New York.

Lucas, Z.N., and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114:46–61.

MacLeod, C., W.F. Perrin, R. Pitman, J. Barlow, L. Ballance, A. D'Amico, T. Gerrodette, G. Joyce, K.D. Mullin, D. L. Palka and G.T. Waring. 2006. Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). J. Cetacean Res. Manage. 7:271–286.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. Endang. Species Res. 7:125–136.

Martín, V., A. Servidio and S. García. 2004. Mass strandings of beaked whales in the Canary Islands. ECS Newsletter 42:33–36.

Mead, J.G. 1984. Survey of reproductive data for the beaked whales (*Ziphiidae*). Rep. Int. Whal. Comm. (Special Issue) 6:91–96.

Mead, J.G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430 *in*: S.H. Ridgway and R. Harrison (eds.). Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego, California.

Morley, J.W., R.L. Selden, R.J. Latour, T.L. Frolicher, R.J. Seagraves and M.L. Pinsky. 2018. Projecting shifts in thermal habitat for 686 species on the North American continental shelf. PLoS ONE 13(5):e0196127.

Murphy, S., R.J. Law, R. Deaville, J.Barnett, M W. Perkins, A. Brownlow, R. Penrose, N.J. Davison, J.L. Barber P.D. Jepson. 2018. Organochlorine contaminants and reproductive implication in cetaceans: A case study of the common dolphin. Pages 3–38 *in* M.C. Fossi and C. Panti, (eds.) Marine mammal ecotoxicology:Impacts of multiple stressors on population health. Academic Press, New York, New York.

NMFS [National Marine Fisheries Service]. 2001. Joint interim report on the Bahamas marine mammal stranding event of 15-16 March 2000 (December 2001). NOAA unpublished report. 55 pp. https://repository.library.noaa.gov/view/noaa/16198

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. NOAA Tech. Memo. NMFS-OPR-59, 167 pp. Available from: https://repository.library.noaa.gov/view/noaa/17892

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2018. Annual report of a comprehensive assessment of marine mammal, marine turtle, and seabird abundance and spatial distribution in US waters of the western North Atlantic Ocean. Northeast Fish. Sci. Cent. Ref. Doc. 18-04. 141 pp. Available at: https://www.fisheries.noaa.gov/resource/publication-database/atlantic-marine-assessment-program-protected-species.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2019. 2018 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US waters of the Western North Atlantic Ocean – AMAPPS II. 121 pp. Available at: https://repository.library.noaa.gov/view/noaa/22040.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2020. 2019 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean - AMAPPS II. https://doi.org/10.25923/v2pq-ht50

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.

Nye, J., J. Link, J. Hare and W. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Mar. Ecol. Prog. Ser. 393:111–129.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. https://repository.library.noaa.gov/view/noaa/5258

Palka, D.L. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. Northeast Fish. Sci. Cent. Ref. Doc. 12-29. 37 pp. https://repository.library.noaa.gov/view/noaa/4312

Palka, D. 2020. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2016 line transect surveys conducted by the Northeast Fisheries Science Center. Northeast Fish. Sci. Cent. Ref. Doc. 20-05.

Palka, DL. 2023. Cetacean abundance in the US Northwestern Atlantic Ocean, Summer 2021. Northeast Fish. Sci. Cent. Ref. Doc. 23-08.

Pierce, G.J. M.B. Santos, S. Murphy, J.A. Learmonth, A.F. Zuur, E. Rogan, P. Bustamante, F. Caurant, V. Lahaye, V. Ridoux, B.N. Zegers, A. Mets, M. Addink, C. Smeenk, T. Jauniaux, R.J. Law, W. Dabin, A. López, J.M. Alonso Farré, A.F. González, A. Guerra, M. García-Hartmann, R.J. Reid, C.F. Moffat, C. Lockyer, J.P. Boon. 2008. Bioaccumulation of persistent organic pollutants in female common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*) from western European seas: Geographical trends, causal factors and effects on reproduction and mortality. Environmental Pollution. 153:401–415.

Pinsky, M.L., B. Worm, M.J. Fogarty, J.L. Sarmiento and S.A. Levin. 2013. Marine taxa track local climate velocities. Science 341:1239–1242.

Poloczanska, E.S., C.J. Brown, W.J. Sydeman, W. Kiessling, D.S. Schoeman, P.J. Moore, K. Brander, J.F. Bruno, L.B. Buckley, M.T. Burrows, C.M. Duarte, B.S. Halpern, J. Holding, C.V. Kappel, M.I. O'Connor, J.M. Pandolfi, C. Parmesan, F. Schwing, S.A. Thompson and A.J. Richardson. 2013. Global imprint of climate change on marine life. Nat. Clim. Change 3:919–925.

Simmonds, M.P., and L.F. Lopez-Jurado. 1991. Whales and the military. Nature 351:448.
Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.
Stanistreet, J.E., Nowacek, D.P., Baumann-Pickering, S., Bell, J.T., Cholewiak, D.M., Hildebrand, J.A., Hodge, L.E., Moors-Murphy, H.B., Van Parijs, S.M. and Read, A.J., 2017. Using passive acoustic monitoring to document the distribution of beaked whale species in the western North Atlantic Ocean. Canadian Journal of Fisheries and Aquatic Sciences, 74(12), pp.2098-2109.
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.
Tove, M. 1995. Live sighting of *Mesoplodon cf. M. mirus*, True's beaked whale. Mar. Mamm. Sci. 11:80–85.
Trickey, J.S., Cárdenas-Hinojosa, G., Rojas-Bracho, L., Schorr, G.S., Rone, B.K., Hidalgo-Pla, E., Rice, A. and Baumann-Pickering, S., 2022. Ultrasonic antifouling devices negatively impact Cuvier's beaked whales near Guadalupe Island, México. Communications Biology, 5(1), p.1005.
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.

TAMANEND'S BOTTLENOSE DOLPHIN (*Tursiops erebennus*): Western North Atlantic South Carolina/Georgia Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins, *Tursiops* spp., are found in estuarine, coastal, continental shelf, and oceanic waters of the western North Atlantic (wNA). Two species are found in the wNA off the U.S. East Coast: a smaller species, Tamanend's bottlenose dolphin (*Tursiops erebennus*, Costa et al. 2022), present in estuarine, coastal, and shelf waters from Florida to approximately Long Island, New York, and a larger, more robust species, common bottlenose dolphin (*Tursiops truncatus*), present farther offshore in deeper waters of the continental shelf and slope from Florida to Canada (Mead and Potter 1995). The two species also differ in parasite load and prey preferences (Mead and Potter 1995).

Spatial distribution data (Kenney 1990; Garrison et al. 2017), photo-identification (photo-ID) studies (e.g., Zolman 2002; Speakman et al. 2006; Stolen et al. 2007; Mazzoil et al. 2008), and genetic studies (Caldwell 2001; Rosel et al. 2009; Litz et al. 2012) indicate that *T. erebennus* comprises multiple stocks distributed in coastal and estuarine waters of the wNA. The South Carolina/Georgia Coastal Stock is one such stock.

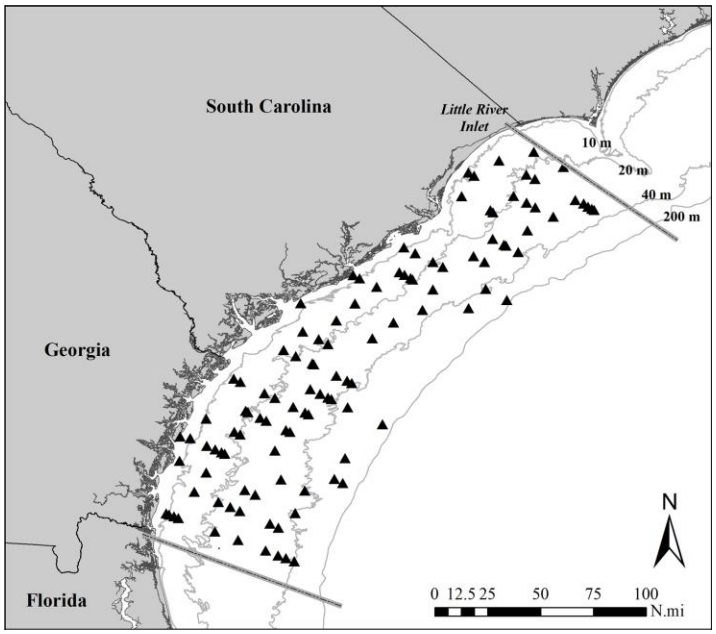


Figure 1. The South Carolina/Georgia Coastal Stock of Tamanend's bottlenose dolphins (Little River Inlet, South Carolina to the Georgia/Florida border). Symbols represent all sightings of bottlenose dolphin groups from NMFS 2010, 2011, 2016 and 2021 aerial surveys within the boundaries of this stock. In waters >20 m, sightings may include the offshore species of bottlenose dolphins. Horizontal gray lines intersecting the coast denote the stock boundaries.

Tamanend's bottlenose dolphins are found in coastal waters south of Cape Hatteras, North Carolina, year-round (Blaylock and Hoggard 1994; Garrison and Yeung 2001; Garrison et al. 2016; Caldwell 2016). Significant genetic differentiation was observed between animals sampled in coastal waters of Georgia and those sampled in coastal waters of Virginia north to New Jersey (Rosel et al. 2009), indicative of demographic independence between animals sampled in these two regions. Speakman et al. (2006), using photo-ID studies, documented dolphins in coastal waters off Charleston, South Carolina, that are not known resident members of the local estuarine stock, revealing that the dolphins present in coastal waters are unlikely to be from the adjacent estuarine stocks. A coast-wide photo-ID catalog established across 15 sites from Cape May, New Jersey, to Cape Canaveral, Florida, found no matches between the northernmost and southernmost sites (Urian et al. 1999), and less movement was seen among southern sites than among northern sites (Urian et al. 1999), supporting the presence of stock structure in coastal waters of this region.

The Western North Atlantic South Carolina/Georgia Coastal Stock includes Tamanend's bottlenose dolphins inhabiting coastal waters from the shoreline to approximately the 200-m isobath from the Little River Inlet, South Carolina (33.8°N), south to the Georgia/Florida border (30.7°N) (Figure 1). The northern and southern boundaries for this stock are provisional as the spatial extent of this stock is poorly understood. These boundaries were derived from

the first delimitation of coastal stocks in 2002 (Waring et al. 2002) when the original single, coast-wide coastal stock suggested by Scott et al. (1988) was broken into seven management units (Waring et al. 2002). The offshore boundary was determined based on a combined genetic and logistic regression analysis that incorporated depth, latitude, and distance from shore to model the probability that a particular bottlenose dolphin group seen in coastal waters south of Cape Hatteras was of the coastal morphotype (Garrison et al. 2017). Dolphins of the coastal morphotype, now *T. erebennus*, were identified in waters out to 97 m depth. The logistic regression predicted that the majority of Tamanend's bottlenose dolphins inhabit waters 0-20 m in depth and that their density declines with increasing depth (Garrison et al. 2017). South of Cape Hatteras in waters less than 20 m depth, 70% of the bottlenose dolphins were predicted to be of the coastal morphotype and fewer than 10% of the animals present beyond 35 m depth were predicted to be of the coastal morphotype (Garrison et al. 2017).

During cold water months (best defined by January and February), this stock likely overlaps with the Southern Migratory Coastal Stock, which is thought to migrate south from waters of southern Virginia and north central North Carolina in the summer to waters south of Cape Fear, North Carolina, and as far south as coastal Florida during winter months. The spatiotemporal overlap of this stock with other stocks complicates the ability to definitively identify the offshore extension for the stock and the assignment of human-caused dolphin mortality to stock at certain times of the year. While bottlenose dolphins do exhibit significant site fidelity (e.g., Zolman 2002; Speakman et al. 2006), it is unlikely this stock contains multiple demographically independent populations as the area inhabited by the stock is relatively homogeneous, does not cross any known biogeographic breaks, nor cover multiple marine ecoregions (Spalding et al. 2007). However, to date, no analyses of stock structure within this stock have been performed.

It should be noted that dolphins in waters between 3 km from shore and the 200-m isobath from the Little River Inlet, South Carolina, to Cape Lookout, North Carolina, in summer are currently not contained with any delimited stock. These dolphins could be members of the South Carolina/Georgia Coastal Stock, but their affinities are currently unknown.

POPULATION SIZE

The best available abundance estimate for the South Carolina/Georgia Coastal Stock of Tamanend's bottlenose dolphins in the western North Atlantic is 9,121 (CV=0.28; Tables 1 and 2; Garrison and Dias 2024). This estimate is derived from aerial surveys conducted during the summer of 2021 covering coastal and shelf waters from Florida to New Jersey.

Background

Estimating the abundance of the South Carolina/Georgia Coastal Stock is complicated by the spatiotemporal overlap the stock has with the Southern Migratory Coastal Stock in cold water months and the potential for the presence, in nearshore coastal waters, of dolphins from estuarine stocks in South Carolina and Georgia. Summer surveys are best for estimating the abundance for this stock because it overlaps least with the Southern Migratory Coastal stock during warm water months. Using the logistic regression described above (Garrison et al. 2017), abundance estimates for the South Carolina/Georgia Coastal Stock were made using sightings observed in the 0-200 m depth range during aerial summer surveys between the Little River Inlet, South Carolina (33.8°N), and the Georgia/Florida border (30.7°N). The regression model was used to estimate the probability that each sighting during the aerial survey is of the coastal (vs. offshore) morphotype, *T. erebennus*. This probability and associated estimates of uncertainty were then incorporated into the abundance estimate for the coastal morphotype within the stock's range (Garrison and Dias 2024).

Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

Recent surveys and abundance estimates

The Southeast Fisheries Science Center conducted aerial surveys of continental shelf waters along the U.S. East Coast from southeastern Florida (26.9°N) to Cape May, New Jersey (40.3°N), during the summer of 2021 (Garrison and Dias 2024). The surveys were conducted along tracklines spaced latitudinally at 20-km intervals and oriented perpendicular to the shoreline, and covered waters from the shoreline to the continental shelf break (Garrison and Dias 2024).

As with previous surveys, the 2021 survey was conducted using a two-team approach to develop estimates of

detection probabilities using the independent observer approach with Distance analysis (Laake and Borchers 2004). The detection function indicated a decreased probability of detection near the trackline. The sighting data were therefore "left-truncated" by analyzing only sightings occurring greater than 75 m from the trackline (see Buckland et al. 2001 for left-truncation methodology). The independent observer method assuming point independence was used to estimate detection probability on the trackline. This estimate accounts for the probability of detecting a marine mammal group conditional on it being available to both survey teams. Covariates that may influence detection probabilities (e.g., sea state, glare, cloud cover, visibility) were incorporated into both the mark-recapture and distance function components of the detection models (Laake and Borchers 2004; Garrison and Dias 2024). The resulting abundance estimate is negatively biased due to the effects of animals spending some time underwater where they are not available to the survey teams. However, due to the relatively short dive times of bottlenose dolphins (Klatsky et al. 2007) and the large group sizes, it is likely that this bias is small (Garrison and Dias 2024). The abundance estimate for the 2021 summer aerial survey was 9,121 (CV=0.28) (Garrison and Dias 2024). Uncertainties in the abundance estimate arise primarily from annual, and unquantified, variation in stock distribution.

Table 1. Summary of abundance estimates for the western North Atlantic South Carolina/Georgia Coastal Stock of Tamanend's bottlenose dolphins. Month, year, and area covered during each abundance survey, and resulting abundance estimate (Nbest) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
June–August 2021	Little River Inlet, South Carolina (33.8°N) to the Georgia/Florida border (30.7°N)	9,121	0.28

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. The best estimate for the South Carolina/Georgia Coastal Stock is 9,121 (CV=0.28). The resulting minimum population estimate is 7,261 (Table 2).

Current Population Trend

Available surveys allow a limited analysis of trend in population size for coastal stocks of Tamanend's bottlenose dolphins. A standardized analytical approach accounting for variation in survey execution and environmental conditions was used to derive unbiased abundance estimates for each survey (Garrison et al. 2017; Garrison and Dias 2024). A weighted generalized linear model was used to evaluate trends in population size by stock using abundance estimates from surveys conducted in the summers of 2002, 2004, 2010, 2011, 2016, and 2021. Abundance estimates were weighted by the inverse of their variance, which reduces the influence of less certain estimates (Neter et al. 1983). Stock was treated as a fixed factor, and surveys were grouped into four periods to test for long term trends in population size: 2002-2004, 2010-2011, 2016, and 2021. Period was also included as a fixed factor in the model along with the interaction between stock and period. Contrasts were specified to test for differences in abundance between periods for each stock (Garrison et al. 2017; Garrison and Dias 2024). For the South Carolina/Georgia Coastal Stock, the resulting mean abundance estimate for 2002-2004 was 9,434 (CV=0.41), for 2010-2011 was 9,567 (CV=0.42), and for 2016 was 6,027 (CV=0.34). There was no significant difference between these estimates and the estimate of 9,121 (CV=0.28) for 2021. There is limited power to detect a significant change given the high CV of the estimates, interannual variability in spatial distribution and stock abundance between 2002 and 2004, and the limited number of surveys available (Garrison et al. 2017; Garrison and Dias 2024). However, see the Strandings section for a discussion of coast-wide trends in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for Tamanend's bottlenose dolphin. The maximum net productivity rate is assumed to be 0.03. This value is based on a population dynamics model showing that bottlenose dolphin populations in the Atlantic Ocean and Gulf of America may not grow at rates much greater than 3% given the constraints of their reproductive life history (Schwacke et al. 2017; 2022).

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; Wade 1998). The

minimum population size of the South Carolina/Georgia Coastal Stock of Tamanend's bottlenose dolphins is 7,261. The maximum productivity rate is 0.03. The recovery factor is 0.5 because this stock is depleted. PBR for this stock of Tamanend's bottlenose dolphins is 54 (Table 2).

Table 2. Best and minimum abundance estimates for the western North Atlantic South Carolina/Georgia Coastal Stock of Tamanend's bottlenose dolphins with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

Nest	CV Nest	Nmin	Fr	Rmax	PBR
9,121	0.28	7,261	0.5	0.03	54

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total mean annual human-caused mortality and serious injury for the South Carolina/Georgia Coastal Stock during 2018-2022 is unknown. The mean annual fishery-related mortality and serious injury for observed fisheries and strandings identified as fishery-related ranged between 0.2 and 0.6. 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 2018-2022 therefore ranged between 0.2 and 0.6 (Table 3). This range reflects several sources of uncertainty and is a minimum because 1) not all fisheries that could interact with this stock are observed, 2) stranding data are used as an indicator of fishery-related mortality and serious injury 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 includes an actual count of verified human-caused deaths and serious injuries and should be considered a minimum (NMFS 2016), and 5) the spatiotemporal overlap between this stock and other Tamanend's bottlenose dolphin stocks introduces uncertainty in assignment of mortality to stock. In the sections below, dolphin mortality was assigned to a stock or stocks by comparing the time and geographic location of the mortality to the stock boundaries and geographic range delimited for each stock.

Fishery Information

There are six commercial fisheries that interact, or that potentially could interact, with this stock. These include four Category II fisheries (Southeastern U.S. Atlantic shark gillnet, Southeast Atlantic gillnet, Southeastern U.S. Atlantic shrimp trawl, and Atlantic blue crab trap/pot fisheries) and two Category III fisheries (Georgia cannonball jellyfish trawl, and Atlantic Ocean, Gulf of America, Caribbean commercial passenger fishing vessel (hook and line) fisheries). Limited or no observer data are available for these fisheries that may interact with this stock. 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), research takes, fisherman self-reported takes (through the Marine Mammal Authorization Program), and opportunistic at-sea observations.

Southeastern U.S. Atlantic Shark Gillnet and Southeast Atlantic Gillnet

There has been no documented mortality or serious injury of Tamanend's bottlenose dolphins associated with the Southeastern U.S. Atlantic Shark Gillnet or Southeast Atlantic Gillnet fisheries during 2018-2022 that could be ascribed to the South Carolina/Georgia Coastal Stock (Mathers et al. 2020; 2024). These fisheries target sharks and finfish in waters between North Carolina and southern Florida. The majority of fishing effort occurs in federal waters because Florida, Georgia, and South Carolina, with limited exceptions, prohibit the use of gillnets in state waters. These fisheries use gillnets set in a sink (anchored), stab, set, strike, or drift fashion. The Southeast Gillnet Observer Program observes these fisheries year-round (e.g., Mathers et al. 2020; 2024).

Shrimp Trawl

During 2018-2022, there was no documented mortality or serious injury of a Tamanend's bottlenose dolphin associated with the shrimp trawl fishery that could be ascribed to the South Carolina/Georgia Coastal Stock. The most recent documented mortality or serious injury due to shrimp trawl gear is from 2013. There has been very little systematic observer coverage of this fishery in the Atlantic during the last decade. Greenman and McFee (2014) suggested shrimp trawl related mortality of Tamanend's bottlenose dolphins in South Carolina was underreported.

Atlantic Blue Crab Trap/Pot

During 2018-2022, there were two mortalities and one serious injury of Tamanend's bottlenose dolphins documented in association with commercial blue crab trap/pot gear. In 2018, one live animal was entangled, released alive, and considered seriously injured (Maze-Foley and Garrison 2022). This animal was ascribed solely to the South Carolina/Georgia Coastal Stock. One mortality occurred in 2020, and another in 2022, and both were ascribed to the South Carolina/Georgia Coastal and Southern Migratory Coastal stocks. All three of these animals were included in the stranding database and in the stranding totals presented in Table 4 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 14 July 2023 (Southeast Region (SER)), and all three were included in the annual human-caused mortality and serious injury total for this stock (Table 3). Because there is no systematic observer program, it is not possible to estimate the total mortality and serious injury associated with crab traps/pots and the documented mortality and serious injury in this commercial gear represents a minimum known count for this fishery.

Georgia Cannonball Jellyfish Trawl

During 2018-2022, there were no documented interactions between Tamanend's bottlenose dolphins and commercial fishing vessels trawling for cannonball jellyfish. Historically, there were two mortalities observed in 2011 and 2012 off the Georgia coast. Initially, this fishery was an experimental fishery but then became a bona fide commercial fishery in 2013 (Page 2015). The fishery operates from October-November to May-June, primarily in federal waters (3-200 nm) offshore of Georgia, with limited effort in Georgia's coastal state waters (Page 2015). Bycatch for this fishery was examined during December 2005–December 2012 by placing observers onboard commercial vessels operating in state and adjacent federal waters. Two bottlenose dolphin mortalities were observed during this study (Page 2015). The state of Georgia continued observer coverage until May 2014 and then ceased observing this fishery. There is currently no federal observer coverage of this fishery.

Hook and Line (Rod and Reel)

During 2018-2022, there was no documented mortality or serious injury of a Tamanend's bottlenose dolphin involving hook and line gear entanglement or ingestion that could be ascribed to the South Carolina/Georgia Coastal Stock. The most recent documented interaction with hook and line gear was from 2017. It is not possible to estimate the total mortality and serious injury from hook and line gear because there is no systematic observer program.

Other Mortality

There was no other mortality or serious injury documented during 2018-2022. All mortality and serious injury from known sources for the South Carolina/Georgia Coastal Stock are summarized in Table 3.

Table 3. Summary of the incidental mortality and serious injury of Tamanend's bottlenose dolphins of the South Carolina/Georgia Coastal Stock. For fisheries with an ongoing, systematic, federal observer program, the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortality and serious injury recorded by on-board observers, and mean annual mortality and serious injury are provided. For fisheries that do not have an ongoing, systematic, federal observer program, counts of mortality and serious injury based on stranding data or fisherman self-reported takes via the Marine Mammal Authorization Program (MMAP) are given. Minimum and maximum values are reported in individual cells when there is uncertainty in the assignment of mortalities to this particular stock due to spatial overlap with the Southern Migratory Coastal Stock. See the Annual Human-Caused Mortality and Serious Injury section for biases and limitations of mortality estimates. NA = not applicable.

Fishery	Years	Data Type	Observer Coverage	Observed Mortality and Serious Injury	Mean Annual Mortality and Serious Injury Based on Observer Data	5-year Min/Max Count Based on Stranding and/or MMAP Data
Southeastern U.S. Atlantic Shark Gillnet	2018-2022	Obs. Data Logbook	NA due to uncertainty in reported effort	0,0,0,0,0	Not estimated	NA
Southeast Atlantic Gillnet	2018-2022	Obs. Data Logbook	NA due to uncertainty in reported effort	0,0,0,0,0	Not estimated	NA
Shrimp Trawl	2018-2022	Limited Observer and MMAP fisherman self-reported mortality and serious injury	NA	NA	NA	0
Atlantic Blue Crab Trap/Pot	2018-2022	Stranding Data	NA	NA	NA	min=1 max=3
Georgia Cannonball Jellyfish Trawl	2018-2022	Stranding data and MMAP fisherman self-reported mortality and serious injury	NA	NA	NA	0
Hook and Line	2018-2022	Stranding Data	NA	NA	NA	0
Mean Annual Mortality due to commercial fisheries (2018-2022)					**min=0.2 max=0.6**	
Mean Annual Mortality due to other sources (2018-2022)					**0**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2018-2022)					**min=0.2 max=0.6**	

STATUS OF STOCK

Tamanend's bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act, but the South Carolina/Georgia Coastal Stock is a strategic stock due to its designation as depleted under the MMPA. From 1995 to 2001, NMFS recognized only the western North Atlantic Coastal Stock of bottlenose dolphins in the western North Atlantic, and this stock was listed as depleted as a result of a UME in 1988-1989 (64 FR 17789, April 6, 1993). The stock structure was revised in 2008, 2009, and 2010, to recognize resident estuarine stocks and migratory and resident coastal stocks. The South Carolina/Georgia Coastal Stock retains the depleted designation as a result of its origin from the western North Atlantic Coastal Stock. This stock is presumed to be below OSP due to its designation as depleted. PBR for the South Carolina/Georgia Coastal Stock is 54 and so the zero mortality rate goal, 10% of PBR, is 5.4. The documented total mean annual human-caused mortality for this stock for 2018-2022 ranged between 0.2 and 0.6. However, these estimates are biased low for the following reasons: 1) the total U.S. human-caused mortality and serious injury for the South Carolina/Georgia Coastal Stock cannot be directly estimated because of the spatial overlap among the stocks of bottlenose dolphins that occupy waters of South Carolina and Georgia resulting in uncertainty in the stock assignment of mortality and serious injury, 2) there are several commercial fisheries operating within this stock's boundaries that have little to no observer coverage, and 3) this mortality estimate incorporates a count of verified human-caused deaths and serious injuries and should be considered a minimum (NMFS 2023). Given these biases and uncertainties, there is insufficient information to determine whether or not the total fishery-related mortality and serious injury is approaching a zero mortality and serious injury rate. The stock may have been negatively impacted by the large 2013-2015 UME and the 2011 UME, and some dolphins in the stock could contain high levels of PCBs from a Superfund site in Georgia. These factors could influence the recovery of this stock. Analysis of trends in abundance suggest a possible decline in stock abundance between 2002-2004 and 2016. The 2021 abundance estimate is higher than that from 2016, but the estimates are not significantly different from each other. However, there is limited power to evaluate trends given uncertainty in stock distribution, lack of precision in abundance estimates, and a limited number of surveys.

OTHER FACTORS THAT MAY BE CAUSING A DECLINE OR IMPEDING RECOVERY

Strandings

There were 126 stranded bottlenose dolphins documented between 2018 and 2022 in the range of the South Carolina/Georgia Coastal Stock (Table 4; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 14 July 2023). It could not be determined whether there was evidence of human interaction for 88 of these strandings, and for 24 it was determined there was no evidence of human interaction. The remaining 14 showed evidence of human interaction, including five fishery interactions (FIs). As mentioned above, three of the FIs were entanglements in commercial blue crab trap/pot gear. One additional human interaction involved an entanglement in research gear and is discussed below. an animal that was released alive without serious injury following entanglement in a research trawl in 2019, and it was ascribed solely to the South Carolina/Georgia Coastal Stock (Maze-Foley and Garrison 2022).

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.

It is worth noting that during winter months, the South Carolina/Georgia Coastal Stock overlaps with the Southern Migratory Coastal Stock and it is currently not possible to assign strandings to a single stock if they are recovered during the time of overlap. Therefore, the counts in Table 4 likely include some animals from the Southern Migratory Coastal Stock and overestimate the total number of strandings for the South Carolina/Georgia Coastal Stock. Of the 126 strandings ascribed to the South Carolina/Georgia Coastal Stock, 63 were ascribed solely to this stock.

This stock has been impacted by three unusual mortality events (UMEs). Two events, one in 1987-1988 and one in 2013-2015, have been attributed to morbillivirus epidemics (Lipscomb et al. 1994; Morris et al. 2015). Both UMEs included deaths of dolphins in spatiotemporal locations that apply to the South Carolina/Georgia Coastal Stock. When the impacts of the 1987-1988 UME were being assessed, only a single coastal stock of bottlenose dolphin was thought to exist along the U.S. eastern seaboard from New York to Florida (Scott et al. 1988), so impacts to the South Carolina/Georgia Coastal Stock alone are not known. However, it was estimated that between 10 and 50% of the

coast-wide stock died as a result of this UME (Scott et al. 1988; Eguchi 2002). The total number of stranded bottlenose dolphins from New York through North Florida (Brevard County) during the 2013-2015 UME was ~1,827, including 305 from South Carolina and Georgia (http://www.nmfs.noaa.gov/pr/health/mmume/midatldolphins2013.html, accessed 8 November 2016). Most strandings and morbillivirus positive animals have been recovered from the ocean side beaches rather than from within the estuaries, suggesting that coastal stocks have been more impacted by this UME than estuarine stocks (Morris et al. 2015). Fourteen strandings considered to be part of the UME were assigned to the South Carolina/Georgia Coastal Stock. During 2015, Balmer et al. (2018) conducted a telemetry and health assessment study during which 19 Tamanend's 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 Southern Georgia Estuarine System Stock (sound and estuary animals). Finally, a UME was declared in South Carolina during February–May 2011. The cause of this UME was undetermined.

Analysis of the coastwide trend in abundance for Tamanend's bottlenose dolphins from 2011 to 2021 suggests the population has returned to 2011 levels, after a period of decline during 2011-2016. An analysis of trends coast-wide (New Jersey to Florida) indicated a statistically significant decline in population size between 2011 and 2016 (Garrison et al. 2017). A weighted generalized linear model was used to evaluate trends in coast-wide population size based on aerial surveys conducted between 2002 and 2016 (see Population Size above for survey descriptions). The model included a linear term for survey year and an interaction term to test for a difference in slope between 2002-2011 and 2011-2016. Estimates were weighted by the inverse of their standard error to reduce the influence of less certain estimates. There was no significant trend in population size between 2002 and 2011; however, there was a statistically significant (p=0.0308) change in slope between 2011 and 2016, indicating a decline in population size. Extending this analysis with the coast-wide estimate from 2021 suggests increasing coast-wide abundance since 2016 (Garrison and Dias 2024). The coast-wide inverse-variance weighted average estimate for Tamanend's bottlenose dolphins during 2011 was 41,456 (CV=0.30), the estimate during 2016 was 19,470 (CV=0.23; Garrison et al. 2017), and the estimate for 2021 was 32,523 (CV=0.23; Garrison and Dias 2024). It is possible that the apparent decline in Tamanend's bottlenose dolphin abundance in coastal waters along the eastern seaboard was a result of the 2013-2015 UME.

Table 4. Strandings of Tamanend's bottlenose dolphins during 2018-2022 ascribed to the South Carolina/Georgia Coastal Stock, 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. Assignments to stock were based upon the understanding of the seasonal movements of the coastal stocks. However, there is overlap between this stock and the Southern Migratory Coastal Stock during winter months, and it is currently not possible to distinguish between them. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 14 July 2023). Please note HI does not necessarily mean the interaction caused the animal's death.

State	**2018**			**2019**			**2020**			**2021**			**2022**		
Type	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
South Carolina	2a	8	9	2b	8	8	3c	1	6	1	0	9	1[d]	3	10
Georgia	2	3	10	0	0	8	2	0	12	0	1	9	1	0	7

Annual Total	**34**	**26**	**24**	**20**	**22**

[a] Includes 1 fisheries interaction (FI), an entanglement in commercial blue crab trap/pot gear (released alive, considered seriously injured post-mitigation).
[b] Includes 1 entanglement interaction in a research trawl (released alive, considered not seriously injured).
[c] Includes 2 FIs, one of which was an entanglement interaction in commercial blue crab trap/pot gear (mortality).
[d] Includes 1 FI, an entanglement interaction in commercial blue crab trap/pot gear (mortality).

Research Gear

In 2019, one animal was released alive without serious injury following an entanglement interaction with a research trawl (Maze-Foley and Garrison 2022). This animal was ascribed solely to the South Carolina/Georgia Coastal Stock, and the case was included within the stranding database (Table 4; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 14 July 2023 (SER)).

Habitat Issues

The nearshore and estuarine habitats occupied by Tamanend's bottlenose dolphins are adjacent to areas of high human population and some are highly industrialized. Studies have examined persistent organic pollutant concentrations in bottlenose dolphins inhabiting estuaries along the Atlantic coast and have found evidence of high blubber concentrations particularly near Brunswick, Georgia, Charleston, South Carolina, and Beaufort, North Carolina (Hansen et al. 2004; Balmer et al. 2011; Kucklick et al. 2011). 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; Balmer et al. 2011). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells et al. 2005). Balmer et al. (2011) reported extremely high levels of total PCBs in dolphins sampled in estuarine waters near Brunswick, Georgia, where there is a point source Superfund site. Dolphins that have been sighted exclusively in estuarine waters 40 km north of Brunswick, near Sapelo Island, Georgia, also exhibit elevated PCB levels (Balmer et al. 2011). Movement of contaminated prey may be the source of exposure for the dolphins in Sapelo Island (Balmer et al. 2011), and, if those prey enter the coastal environment, the South Carolina/Georgia Coastal Stock could also be exposed to these unusually high contaminant levels. The exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

Changes in spatial distribution and abundance in response to long-term environmental changes, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Pinsky et al. 2013; Poloczanska et al. 2013; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019; Chavez-Rosales et al. 2022; Thorne et al. 2022). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat/environmental factors. Results varied by season and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys between 2010 and 2017. During this time frame, the weighted centroid of the common bottlenose dolphin (including both coastal and offshore stocks) core habitat moved towards the northeast in all seasons, where the farthest was during fall (753 km) and the least was during winter (211 km). In addition, an assessment was conducted for the western North Atlantic non-migratory coastal stocks, which included the South Carolina/Georgia Coastal Stock, to estimate vulnerability to environmental change (Lettrich et al. 2023). The stock was categorized with a vulnerability index resulting from assessments of sensitivity (ability to tolerate and adapt to environmental change) and exposure (projected change in environmental conditions). The non-migratory coastal stocks had an overall rank of "high" vulnerability to long-term environmental change (Lettrich et al. 2023).

REFERENCES CITED

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., 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.

Blaylock, R.A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo. NMFS-SEFSC-356, 10 pp.

Buckland, S. T., D. R. Andersen, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York. 432 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. dissertation from University of Miami. 143 pp.

Caldwell, M. 2016. 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.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580.

Costa, A., W. Mcfee, L. Wilcox, F. Archer, and P. Rosel. 2022. The common bottlenose dolphin (*Tursiops truncatus*) ecotypes of the western North Atlantic revisited: an integrative taxonomic investigation supports the presence of distinct species. Zool. J. Linn. Soc. 196:1608–1636.

Eguchi, T. 2002. A method for calculating the effect of a die-off from stranding data. Mar. Mamm. Sci. 18(3):698–709.

Garrison, L.P. and C. Yeung. 2001. Abundance estimates for Atlantic bottlenose dolphin stocks during summer and winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L.P. and L.A. Dias. 2024. Abundance of Tamanend's bottlenose dolphins (*Tursiops erebennus*) along the U.S. Atlantic Coast from aerial surveys conducted during summer 2021. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2024-04. 25 pp.

Garrison, L.P., P.E. Rosel, A.A. Hohn, R. Baird and W. Hoggard. 2016. Abundance of the coastal morphotype of bottlenose dolphin *Tursiops truncatus*, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2017-03, 135 pp.

Garrison, L.P., K. Barry and W. Hoggard. 2017. The abundance of coastal morphotype bottlenose dolphins on the U.S. east coast: 2002-2016. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2017-01, 37 pp.

Greenman, J.T. and W.E. McFee. 2014. A characterisation of common bottlenose dolphin (*Tursiops truncatus*) interactions with the commercial shrimp trawl fishery of South Carolina, USA. J. Cetacean Res. Manage. 14: 69–79.

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 organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. Sci. Total Environ. 319:147–172.

Kenney, R.D. 1990. Bottlenose dolphins off the northeastern United States. pp. 369-386. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Klatsky, L.J., R.S. Wells, and J.C. Sweeney. 2007. Offshore bottlenose dolphins (*Tursiops truncatus*): Movement and dive behavior near the Bermuda Pedestal. Journal of Mammalogy 88:59-66.

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.

Laake, J.L. and D.L. Borchers. 2004. Methods for incomplete detection at distance zero. pp. 108-189. *In:* S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.) Advanced distance sampling. Oxford University Press, New York.

Lipscomb, T.P., F.Y. Schulman, D. Moffett and S. Kennedy. 1994. Morbilliviral disease in Atlantic bottlenose dolphins (*Tursiops truncatus*) from the 1987–1988 epizootic. J. Wildl. Dis. 30:567–571.

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.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: A review and synthesis. Endang. Species Res. 7:125–136.

Mathers, A.N., B.M. Deacy, H.E. Moncrief-Cox and J.K. Carlson. 2020. Catch and bycatch in U.S. Southeast gillnet fisheries, 2018. NOAA Tech. Memo. NMFS-SEFSC-743. 15 pp.

Mathers, A.N., B.A. Smith, D.E. Jordan, J.K. Carlson, and S. Leach. 2024. Observer coverage of the Southeast U.S. Shark Bottom Longline and Gillnet Fisheries: 2019–2023. NOAA Tech. Memo. NMFS-SEFSC-787, 44 pp.

Maze-Foley, K. and L.P. Garrison. 2022. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2022-02. 69 pp. https://repository.library.noaa.gov/view/noaa/48483

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

Mead, J.G. and C.W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: Morphological and ecological considerations. IBI Reports 5:31–44.

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.

Neter, J., W. Wasserman and M. Kutner. 1983. Applied linear regression models. Richard D. Irwin, Inc., Homewood, Illinois. 547 pp.

NMFS. 2023. Guidelines for Preparing Stock Assessment Reports Pursuant to the Marine Mammal Protection Act. Protected Resources Policy Directive 02-204-01. https://www.fisheries.noaa.gov/s3/2023-05/02-204-01-Final-GAMMS-IV-Revisions-clean-1-kdr.pdf

Page, J.W. 2015. Characterization of bycatch in the cannonball jellyfish fishery in the coastal waters off Georgia, Marine and Coastal Fisheries, 7(1):190–199.

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. Mol. Ecol. 18:5030–5045.

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. 21:2752–2764.

Schwacke, L.H., L. Thomas, R.S. Wells, W.E. McFee, A.A. Hohn, K.D. Mullin, E.S. Zolman, B.M. Quigley, T.K. Rowles and J.H. Schwacke. 2017. Quantifying injury to common bottlenose dolphins from the *Deepwater Horizon* oil spill using an age-, sex- and class-structured population model. Endanger. Spec. Res. 33:265–279.

Schwacke, L.H., T.A. Marques, L. Thomas, C.G. Booth, B.C. Balmer, A. Barratclough, K. Colegrove, S. De Guise, L.P. Garrison, F.M. Gomez, J.S. Morey, K.D. Mullin, B.M. Quigley, P.E. Rosel, T.K. Rowles, R. Takeshita, F.I. Townsend, T.R. Speakman, R.S. Wells, E.S. Zolman, and C.R. Smith. 2022. Modeling population effects of the Deepwater Horizon oil spill on a long-lived species. Conserv. Biol. 36(4):e13878. 13 pp.

Scott, G.P., D.M. Burn and L.J. Hansen. 1988. The dolphin die off: Long term effects and recovery of the population. Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8, Vol. 3:819–823.

Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.

Spalding, M.D., H.E. Fox, G.R. Allen, N. Davidson, Z.A. Ferdaña, M. Finlayson, B.S. Halpern, M.A. Jorge, A. Lombana and S.A. Lourie. 2007. Marine ecoregions of the world: A bioregionalization of coastal and shelf areas. BioScience 57(7):573–583.

Speakman, T., E.S. 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, 243 pp.

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.

Thorne, L.H., E.I. Heywood and N.O. Hirtle. 2022. Rapid restructuring of the odontocete community in an ocean warming hotspot. Glob. Change Biol. 00:1–17.

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 Admin. Report NMFS-SEFSC-425, 22 pp.

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, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Waring, G.T., J.M. Quintal and C.P. Fairfield, eds. 2002. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments -- 2002. NOAA Tech. Memo. NMFS-NE-169, 318 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., V. Tornero, A. Borrell, A. Aguilar, T.K. Rowles, H.L. Rhinehart, S. Hofmann, W.M. Jarman, A.A. Hohn and J.C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349:106–119.

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

TAMANEND'S BOTTLENOSE DOLPHIN (*Tursiops erebennus*): Western North Atlantic Northern Florida Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins, *Tursiops* spp., are found in estuarine, coastal, continental shelf, and oceanic waters of the western North Atlantic (wNA). Two species are found in the wNA off the U.S. East Coast: a smaller species, Tamanend's bottlenose dolphin (*Tursiops erebennus*, Costa et al. 2022), present in estuarine, coastal, and shelf waters from Florida to approximately Long Island, New York, and a larger, more robust species, common bottlenose dolphin (*Tursiops truncatus*), present farther offshore in deeper waters of the continental shelf and slope from Florida to Canada (Mead and Potter 1995). The two species also differ in parasite load and prey preferences (Mead and Potter 1995).

Spatial distribution data (Kenney 1990; Garrison et al. 2017), photo-identification (photo-ID) studies (e.g., Zolman 2002; Speakman et al. 2006; Stolen et al. 2007; Mazzoil et al. 2008), and genetic studies (Caldwell 2001; Rosel et al. 2009; Litz et al. 2012) indicate that *T. erebennus* comprises multiple stocks distributed in coastal and estuarine waters of the wNA. The Northern Florida Coastal Stock is one such stock.

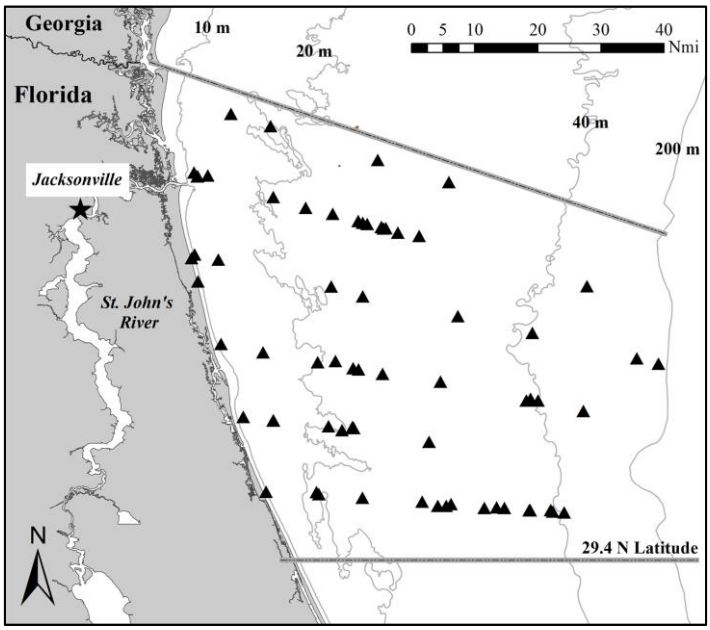


Figure 1. The Northern Florida Coastal Stock of Tamanend's bottlenose dolphins (Georgia/Florida border to 29.4°N). Symbols represent all sightings of bottlenose dolphin groups from NMFS 2010, 2011, 2016, and 2021 aerial surveys within the boundaries of this stock. In waters > 20 m, sightings may include the offshore species of bottlenose dolphins. Horizontal gray lines intersecting the coast denote the stock

Tamanend's bottlenose dolphins are found in coastal waters south of Cape Hatteras, North Carolina, to southern Florida year-round (Blaylock and Hoggard 1994; Garrison and Yeung 2001; Garrison et al. 2016; Caldwell 2016). Significant genetic differentiation was observed between animals sampled in coastal waters of Georgia and those sampled in the Jacksonville, Florida, area (Rosel et al. 2009), indicative of demographic independence between animals sampled in these two coastal regions. Genetic analyses of dolphins sampled in coastal and estuarine waters near both Jacksonville, Florida, and the Indian River Lagoon, Florida, revealed significant differentiation (Rosel et al. 2009; Richards et al. 2013), indicating the presence of demographically independent coastal and estuarine stocks along the Florida coast. Similarly, photo-ID studies in the same area distinguished between dolphins that used coastal waters and those using estuarine waters of the intracoastal waterway and St. John's River (Caldwell 2001; 2016).

The Northern Florida Coastal Stock includes Tamanend's bottlenose dolphins inhabiting coastal waters from the shoreline to approximately the 200-m isobath from the Georgia/Florida border (30.7°N) south to 29.4°N (Figure 1). The northern and southern boundaries for this stock are provisional as the spatial extent of this stock is poorly understood. These boundaries are derived from the first delimitation of coastal stocks in 2002 (Waring et al. 2002) when the original single, coast-wide coastal stock suggested by Scott et al. (1988) was broken into seven management units (Waring et al. 2002). The offshore boundary was determined based on a combined genetic and logistic regression analysis that incorporated depth, latitude, and distance from shore to model the probability that a particular bottlenose dolphin group seen in coastal waters south of Cape Hatteras was of the coastal morphotype (Garrison et al. 2017).

Dolphins of the coastal morphotype, now *T. erebennus*, were identified in waters out to 97 m depth. The logistic regression predicted that the majority of Tamanend's bottlenose dolphins inhabit waters 0-20 m in depth and that their density declines with increasing depth (Garrison et al. 2017). South of Cape Hatteras in waters less than 20 m depth, 70% of the bottlenose dolphins were predicted to be of the coastal morphotype and fewer than 10% of the animals present beyond 35 m depth were predicted to be of the coastal morphotype (Garrison et al. 2017).

While bottlenose dolphins do exhibit significant site fidelity, it is unlikely this stock contains multiple demographically independent populations because the habitat inhabited by the stock is relatively homogeneous, it does not cross any known biogeographic breaks nor cover multiple marine ecoregions (Spalding et al. 2007). Recently, Caldwell (2016) reported that three dolphins sighted behind trawling shrimp boats offshore of Jacksonville, Florida, were also photographed behind shrimp boats trawling off Hilton Head and/or Myrtle Beach, South Carolina. These sightings suggest the stock may cover a larger area. To date, no analyses of stock structure within this stock have been performed.

During cold water months, this stock likely overlaps with the Southern Migratory Coastal Stock, which is thought to migrate south from waters of southern Virginia and north central North Carolina in the summer to waters south of Cape Fear and as far south as coastal Florida during winter months. There is no firm boundary defining the offshore extent of the Northern Florida Coastal Stock and it overlaps to some degree with the Offshore Stock of common bottlenose dolphins (Garrison et al. 2017). The spatiotemporal overlap of this stock with other stocks complicates the ability to definitively identify the offshore extension for the stock and the assignment of human-caused dolphin mortalities to stock at certain times of the year.

POPULATION SIZE

The best available abundance estimate for the Northern Florida Coastal Stock of Tamanend's bottlenose dolphins in the western North Atlantic is 3,619 (CV=0.35; Tables 1 and 2; Garrison and Dias 2024). This estimate is derived from aerial surveys conducted during the summer of 2021 covering coastal and shelf waters from Florida to New Jersey.

Background

Estimating the abundance of the Northern Florida Coastal Stock is complicated by the spatiotemporal overlap the stock has with the Southern Migratory Coastal Stock in cold water months, the potential for some overlap with the wNA Offshore Stock, and by the presence, in nearshore coastal waters, of dolphins from estuarine stocks in Florida (Mazzoil et al. 2011; Caldwell 2016). Summer surveys are best for estimating the abundance for this stock because it overlaps least with the Southern Migratory Coastal Stock during warm water months. Using the logistic regression described above (Garrison et al. 2017), abundance estimates for the Northern Florida Coastal Stock were made using sightings observed in the 0-200 m depth stratum during summer aerial surveys between the Georgia/Florida border and 29.4°N. The regression model was used to estimate the probability that each sighting during the aerial survey is of the coastal (vs. offshore) species, *T. erebennus*. This probability and associated estimates of uncertainty were then incorporated into the abundance estimate for the coastal species within the stock's range (Garrison et al. 2017).

Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

Recent surveys and abundance estimates

The Southeast Fisheries Science Center conducted aerial surveys of continental shelf waters along the U.S. East Coast from southeastern Florida (26.9°N) to Cape May, New Jersey (40.3°N), during the summer of 2021 (Garrison and Dias 2024). The surveys were conducted along tracklines spaced latitudinally at 20-km intervals and oriented perpendicular to the shoreline, and covered waters from the shoreline to the continental shelf break (Garrison and Dias 2024).

As with previous surveys, the 2021 survey was conducted using a two-team approach to develop estimates of detection probabilities using the independent observer approach with Distance analysis (Laake and Borchers 2004). The detection function indicated a decreased probability of detection near the trackline. The sighting data were therefore "left-truncated" by analyzing only sightings occurring greater than 75 m from the trackline (see Buckland et al. 2001 for left-truncation methodology). The independent observer method assuming point independence was used to estimate detection probability on the trackline. This estimate accounts for the probability of detecting a marine

mammal group conditional on it being available to both survey teams. Covariates that may influence detection probabilities (e.g., sea state, glare, cloud cover, visibility) were incorporated into both the mark-recapture and distance function components of the detection models (Laake and Borchers 2004; Garrison and Dias 2024). The resulting abundance estimate is negatively biased due to the effects of animals spending some time underwater where they are not available to the survey teams. However, due to the relatively short dive times of bottlenose dolphins (Klatsky et al. 2007) and the large group sizes, it is likely that this bias is small (Garrison and Dias 2024).

The abundance estimate for the 2021 summer aerial survey was 3,619 (CV=0.35) (Garrison and Dias 2024). Uncertainties in the abundance estimate arise primarily from annual, and unquantified, variation in stock distribution.

Table 1. Summary of abundance estimates for the western North Atlantic Northern Florida Coastal Stock of Tamanend's bottlenose dolphins. Month, year, and area covered during each abundance survey, and resulting abundance estimate (Nest) and coefficient of variation (CV).

Month/Year	Area	Nest	CV
June–August 2021	Georgia/Florida border (30.7°N to 29.4°N latitude	3,619	0.35

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. The best estimate for the Northern Florida Coastal Stock is 3,619 (CV=0.35). The resulting minimum population estimate is 2,711 (Table 2).

Current Population Trend

Available surveys allow a limited analysis of trend in population size for coastal stocks of Tamanend's bottlenose dolphins. A standardized analytical approach accounting for variation in survey execution and environmental conditions was used to derive unbiased abundance estimates for each survey (Garrison et al. 2017; Garrison and Dias 2024). A weighted generalized linear model was used to evaluate trends in population size by stock using abundance estimates from surveys conducted in the summers of 2002, 2004, 2010, 2011, 2016, and 2021. Abundance estimates were weighted by the inverse of their variance, which reduces the influence of less certain estimates (Neter et al. 1983). Stock was treated as a fixed factor, and surveys were grouped into four periods to test for long term trends in population size: 2002-2004, 2010-2011, 2016, and 2021. Period was also included as a fixed factor in the model along with the interaction between stock and period. Contrasts were specified to test for differences in abundance between periods for each stock (Garrison et al. 2017; Garrison and Dias 2024). For the Northern Florida Coastal Stock, the resulting mean abundance estimate for 2002-2004 was 740 (CV=1.81), for 2010-2011 was 5,270 (CV=0.71), and for 2016 was 877 (CV=0.49). There was no significant difference between these estimates and the estimate of 3,619 (CV=0.35) for 2021. There is limited power to detect a significant change given the high CV of the estimates, interannual variability in spatial distribution and stock abundance between 2002 and 2004, and the limited number of surveys available (Garrison et al. 2017; Garrison and Dias 2024). However, see the Strandings section for a discussion of coast-wide trends in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for Tamanend's bottlenose dolphin. The maximum net productivity rate was assumed to be 0.03. This value is based on a population dynamics model showing that bottlenose dolphin populations in the Atlantic Ocean and Gulf of America may not grow at rates much greater than 3% given the constraints of their reproductive life history (Schwacke et al. 2017; 2022).

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; Wade 1998). The minimum population size of the Northern Florida Coastal Stock of Tamanend's bottlenose dolphins is 2,711. The maximum productivity rate is 0.03. The recovery factor is 0.5 because this stock is depleted. PBR for this stock of Tamanend's bottlenose dolphins is 20.

Table 2. Best and minimum abundance estimates for the western North Atlantic Northern Florida Coastal Stock of Tamanend's bottlenose dolphins with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

Nest	CV Nest	Nmin	Fr	Rmax	PBR
3,619	0.35	2,711	0.5	0.03	20

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the Northern Florida Coastal Stock during 2018-2022 is unknown. The mean annual fishery-related mortality and serious injury for strandings identified as fishery-related was 0. Mean annual mortality and serious injury due to other human-caused sources (entanglement in unidentified line) was 0.2. Therefore, the minimum total mean annual human-caused mortality and serious injury for this stock during 2018-2022 was 0.2 (Table 2). This is a minimum estimate because 1) not all fisheries that could interact with this stock are observed, 2) stranding data are used as an indicator of fishery-related interactions and not all dead animals are detected and 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 includes an actual count of verified human-caused deaths and serious injuries and should be considered a minimum (NMFS 2016). In the sections below, dolphin mortalities were assigned to a stock or stocks by comparing the time and geographic location of the mortality to the stock boundaries and geographic range delimited for each stock.

Fishery Information

There are five commercial fisheries that interact, or that potentially could interact, with this stock. These include four Category II fisheries (Southeastern U.S. Atlantic shark gillnet, Southeast Atlantic gillnet, Southeastern U.S. Atlantic shrimp trawl, and Atlantic blue crab trap/pot fisheries) and one Category III fishery (Atlantic Ocean, Gulf of America, Caribbean commercial passenger fishing vessel (hook and line) fishery). Only limited observer data are available for these and other fisheries that may interact with this stock. 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), research takes, fisherman self-reported takes (through the Marine Mammal Authorization Program), and opportunistic at-sea observations.

Southeastern U.S. Atlantic Shark Gillnet and Southeast Atlantic Gillnet

There has been no documented mortality or serious injury of a Tamanend's bottlenose dolphin associated with the Southeastern U.S. Atlantic Shark Gillnet or Southeast Atlantic Gillnet fisheries during 2018-2022 that could be ascribed to the Northern Florida Coastal Stock (Mathers et al. 2020; 2024). These fisheries target sharks and finfish in waters between North Carolina and southern Florida. The majority of fishing effort occurs in federal waters because Florida, Georgia, and South Carolina, with limited exceptions, prohibit the use of gillnets in state waters. These fisheries use gillnets set in a sink (anchored), stab, set, strike, or drift fashion. The Southeast Gillnet Observer Program observes these fisheries year-round (e.g., Mathers et al. 2020; 2024).

Shrimp Trawl

During 2018-2022, there was no documented mortality or serious injury in association with the shrimp trawl fishery that could be ascribed to the Northern Florida Coastal Stock. While no mortality or serious injury has been reported thus far, the potential for interactions exists in this area. Caldwell (2016) reported that bottlenose dolphins were regularly sighted behind trawling shrimp boats in coastal waters of northern Florida, and that the shrimp trawl fishing industry may influence movements of coastal dolphins. There has been very little systematic observer coverage of this fishery during the last decade, so it is not possible to estimate the total number of mortality and serious injury associated with the shrimp trawl fishery.

Atlantic Blue Crab Trap/Pot

During 2018-2022, there was no documented mortality or serious injury in crab trap/pot gear that could be ascribed to the Northern Florida Coastal Stock. The most recent documented interaction with this fishery was from 2009. Because there is no systematic observer program, it is not possible to estimate the total mortality and serious injury associated with crab traps/pots. Stranding data indicate that interactions with trap/pot gear occur at some

unknown level in North Carolina (Byrd et al. 2014) and other regions of the southeast U.S. (Noke and Odell 2002; Burdett and McFee 2004).

Hook and Line (Rod and Reel)

During 2018-2022, there was no documented mortality or serious injury of a Tamanend's bottlenose dolphin involving hook and line gear entanglement or ingestion that could be ascribed to the Northern Florida Coastal Stock. The most recent documented interaction with hook and line gear was from 2016. It is not possible to estimate the total number of mortality and serious injury with hook and line gear because there is no systematic observer program.

Other Mortality

During 2018-2022, there was one at-sea observation of a Tamanend's bottlenose dolphin entangled in unidentified line. The entanglement occurred in 2019, and it could not be determined if the animal was seriously injured or not (Maze-Foley and Garrison 2022); therefore, this case was prorated as a serious injury based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison 2022) and is included in the annual human-caused mortality and serious injury total for this stock (Table 3). Historically, there have been occasional mortalities of bottlenose dolphins during research activities (Waring et al. 2016); however, none were documented during 2018-2022 that could be ascribed to the Northern Florida Coastal Stock.

All mortality and serious injury from known sources for the Northern Florida Coastal Stock are summarized in Table 3.

Table 3. Summary of the incidental mortality and serious injury of Tamanend's bottlenose dolphins of the Northern Florida Coastal Stock. For fisheries with an ongoing, systematic, federal observer program, the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortality and serious injury recorded by on-board observers, and mean annual mortality and serious injury are provided. For fisheries that do not have an ongoing, systematic, federal observer program, minimum counts of mortality and serious injury based on stranding data or fisherman self-reported takes via the Marine Mammal Authorization Program (MMAP) are given. See the Annual Human-Caused Mortality and Serious Injury section for biases and limitations of mortality estimates. NA = not applicable

Fishery	Years	Data Type	Observer Coverage	Observed Mortality and Serious Injury	Mean Annual Mortality and Serious Injury Based on Observer Data	5-year Count Based on Stranding and/or MMAP Data
Southeastern U.S. Atlantic Shark Gillnet	2018-2022	Obs. Data Logbook	NA due to uncertainty in reported effort	0,0,0,0,0	Not estimated	NA
Southeast Atlantic Gillnet	2018-2022	Obs. Data Logbook	NA due to uncertainty in reported effort	0,0,0,0,0	Not estimated	NA
Shrimp Trawl	2018-2022	Limited Observer and MMAP fisherman self-reported mortality and serious injury	NA	NA	NA	0
Atlantic Blue Crab Trap/Pot	2018-2022	Stranding Data	NA	NA	NA	0

Hook and Line	2018-2022	Stranding Data	NA	NA	NA	0
Mean Annual Mortality due to commercial fisheries (2018-2022)					**0**	
Other Mortality and Serious Injury (entanglement in unidentified line; 5-year Count)					1	
Mean Annual Mortality and Serious Injury due to other sources (2018-2022)					**0.2**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2018-2022)					**0.2**	

STATUS OF STOCK

Tamanend's bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act, but the Northern Florida Coastal Stock is a strategic stock due to its designation as depleted under the MMPA. From 1995 to 2001, NMFS recognized only the western North Atlantic Coastal Stock of bottlenose dolphins in the western North Atlantic, and this stock was listed as depleted as a result of a UME in 1988-1989 (64 FR 17789, April 6, 1993). The stock structure was revised in 2008, 2009, and 2010, to recognize resident estuarine stocks and migratory and resident coastal stocks. The Northern Florida Coastal Stock retains the depleted designation as a result of its origin from the western North Atlantic Coastal Stock. This stock is presumed to be below OSP due to its designation as depleted. PBR for the Northern Florida Coastal Stock is 20 and so the zero mortality rate goal, 10% of PBR, is 2.0. The documented total mean annual human-caused mortality for this stock for 2018-2022 was 0.2. However, this estimate is biased low for the following reasons: 1) there are several commercial fisheries operating within this stock's boundaries that have little to no observer coverage, and 2) this mortality estimate incorporates a count of verified human-caused deaths and serious injuries and should be considered a minimum (NMFS 2023). Given these biases and uncertainties, there is insufficient information to determine whether or not the total fishery-related mortality and serious injury is approaching a zero mortality and serious injury rate. The stock may have been negatively impacted by the large 2013-2015 UME and some dolphins in the stock could contain high levels of PCBs from a Superfund site in Georgia. Both of these factors could influence the recovery of this stock. Analysis of trends in abundance suggest a probable decline in stock size between 2010-2011 and 2016. The 2021 abundance estimate is higher than that from 2016, but the estimates are not significantly different from each other. However, there is limited power to evaluate trends given uncertainty in stock distribution, lack of precision in abundance estimates, and a limited number of surveys.

OTHER FACTORS THAT MAY BE CAUSING A DECLINE OR IMPEDING RECOVERY

Strandings

During 2018-2022, 38 stranded bottlenose dolphins were recovered within the range of the Northern Florida Coastal Stock (Table 4; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 14 July 2023). It could not be determined whether there was evidence of human interaction for 27 of these strandings, and for 10 it was determined there was no evidence of human interaction. For the remaining case, there was evidence of human interaction.

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.

It is worth noting that during winter months, the Northern Florida Coastal Stock likely overlaps with the Southern Migratory Coastal Stock and it is currently not possible to distinguish between them. Therefore, the counts in Table 3 likely include some animals from the Southern Migratory Coastal Stock and overestimate the total number of strandings for the Northern Florida Coastal Stock. Of the 38 strandings ascribed to the Northern Florida Coastal Stock, 24 were ascribed solely to this stock.

This stock has also been impacted by two unusual mortality events (UMEs), one in 1987-1988 and one in 2013-2015. Both UMEs have been attributed to morbillivirus epidemics (Lipscomb et al. 1994; Morris et al. 2015) and both

included deaths of dolphins in spatio-temporal locations that apply to the Northern Florida Coastal Stock. When the impacts of the 1987-1988 UME were being assessed, only a single coastal stock of bottlenose dolphins was thought to exist along the U.S. eastern seaboard from New York to Florida (Scott et al. 1988), so impacts to the Northern Florida Coastal Stock alone are not known. However, it was estimated that between 10 and 50% of the coast-wide stock died as a result of this UME (Scott et al. 1988; Eguchi 2002). The total number of stranded bottlenose dolphins from New York through central Florida (Brevard County) during the 2013-2015 UME was ~1,827, including 319 from northern and central Florida (http://www.nmfs.noaa.gov/pr/health/mmume/midatldolphins2013.html, accessed 8 November 2016). Most strandings and morbillivirus positive animals have been recovered from the ocean side beaches rather than from within the estuaries, suggesting that coastal stocks have been more impacted by this UME than estuarine stocks (Morris et al. 2015).

Analysis of the coastwide trend in abundance for Tamanend's bottlenose dolphins from 2011 to 2021 suggests the population has returned to 2011 levels, after a period of decline during 2011-2016. An analysis of trends coast-wide (New Jersey to Florida) indicated a statistically significant decline in population size between 2011 and 2016 (Garrison et al. 2017). A weighted generalized linear model was used to evaluate trends in coast-wide population size based on aerial surveys conducted between 2002 and 2016 (see Population Size above for survey descriptions). The model included a linear term for survey year and an interaction term to test for a difference in slope between 2002-2011 and 2011-2016. Estimates were weighted by the inverse of their standard error to reduce the influence of less certain estimates. There was no significant trend in population size between 2002 and 2011; however, there was a statistically significant (p=0.0308) change in slope between 2011 and 2016, indicating a decline in population size. Extending this analysis with the coast-wide estimate from 2021 suggests increasing coast-wide abundance since 2016 (Garrison and Dias 2024). The coast-wide inverse-variance weighted average estimate for Tamanend's bottlenose dolphins during 2011 was 41,456 (CV=0.30), the estimate during 2016 was 19,470 (CV=0.23; Garrison et al. 2017), and the estimate for 2021 was 32,523 (CV=0.23; Garrison and Dias 2024). It is possible that the apparent decline in Tamanend's bottlenose dolphin abundance in coastal waters along the eastern seaboard was a result of the 2013-2015 UME.

Table 4. Strandings of Tamanend's bottlenose dolphins during 2018-2022 that were ascribed to the Northern Florida Coastal Stock, 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. Assignments to stock were based upon the understanding of the seasonal movements of the coastal stocks. However, there is overlap between this stock and the Southern Migratory Coastal Stock during winter months, and it is currently not possible to distinguish between them. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 14 July 2023). Please note HI does not necessarily mean the interaction caused the animal's death.

State	**2018**			**2019**			**2020**			**2021**			**2022**		
Type	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
Northern Florida Coastal Stock	0	2	8	1	3	2	0	0	4	0	1	6	0	4	7
Annual Total	10			6			4			7			11		

Habitat Issues

The nearshore and estuarine habitats occupied by Tamanend's bottlenose dolphins are adjacent to areas of high human population and some are highly industrialized. Studies that have examined persistent organic pollutant concentrations in bottlenose dolphins inhabiting estuaries along the Atlantic coast found evidence of high blubber concentrations, particularly near Brunswick, Georgia, Charleston, South Carolina, and Beaufort, North Carolina (Hansen et al. 2004; Balmer et al. 2011; Kucklick et al. 2011). The concentrations found in male dolphins from 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; Balmer et al. 2011). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells et al. 2005). Balmer et al. (2011) reported extremely high levels of total PCBs in dolphins sampled in estuarine waters near Brunswick, Georgia, where there is a point source Superfund site. Dolphins that were sighted exclusively in estuarine waters 40 km north of Brunswick, near Sapelo Island, Georgia, also exhibited elevated PCB levels (Balmer et al. 2011). Movement of contaminated prey may be the source of exposure for the dolphins in Sapelo Island (Balmer et al. 2011), and, if those prey enter the coastal environment, the Northern Florida Coastal Stock could also be exposed to these unusually high contaminant levels, as the northern boundary of the stock is approximately 50 km from Brunswick, Georgia. In fact, Watanabe et al. (2000) reported high levels of the PCB congeners associated with the signature PCB formulation from this Superfund site in one stranded dolphin from northern Florida. The exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

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 and adjacent coastal habitat may be exposed to these cyanotoxins. From 2014 to 2017, liver tissue from three dolphin strandings in Northern Florida Coastal waters tested positive for microcystins and noldularins (Brown et al. 2018). Brown et al. (2018) suggested that the high levels of human activity coupled with environmental stressors characterizing the St. Johns River area could lead to the dolphins utilizing this area being more susceptible to the harmful effects of cyanotoxin exposure.

Changes in spatial distribution and abundance in response to long-term environmental changes, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Pinsky et al. 2013; Poloczanska et al. 2013; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019; Chavez-Rosales et al. 2022; Thorne et al. 2022). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat/environmental factors. Results varied by season and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys between 2010 and 2017. During this time frame, the weighted centroid of the common bottlenose dolphin (including both coastal and offshore stocks) core habitat moved towards the northeast in all seasons, where the farthest was during fall (753 km) and the least was during winter (211 km). In addition, an assessment was conducted for the western North Atlantic non-migratory coastal stocks, which included the Northern Florida Coastal Stock, to estimate vulnerability to environmental change (Lettrich et al. 2023). The stock was categorized with a vulnerability index resulting from assessments of sensitivity (ability to tolerate and adapt to environmental change) and exposure (projected change in environmental conditions). The non-migratory coastal stocks had an overall rank of “high” vulnerability to long-term environmental change (Lettrich et al. 2023).

REFERENCES CITED

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.

Blaylock, R.A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo. NMFS-SEFSC-356, 10 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.

Buckland, S. T., D. R. Andersen, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York. 432 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.

Caldwell, M. 2016. 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.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580.

Costa, A., W. Mcfee, L. Wilcox, F. Archer, and P. Rosel. 2022. The common bottlenose dolphin (*Tursiops truncatus*) ecotypes of the western North Atlantic revisited: an integrative taxonomic investigation supports the presence of distinct species. Zool. J. Linn. Soc. 196:1608–1636.

Eguchi, T. 2002. A method for calculating the effect of a die-off from stranding data. Mar. Mamm. Sci. 18(3):698–709.

Garrison, L.P. and C. Yeung. 2001. Abundance estimates for Atlantic bottlenose dolphin stocks during summer and winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L.P. and L.A. Dias. 2024. Abundance of Tamanend's bottlenose dolphins (*Tursiops erebennus*) along the U.S. Atlantic Coast from aerial surveys conducted during summer 2021. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2024-04. 25 pp.

Garrison, L.P., P.E. Rosel, A.A. Hohn, R. Baird and W. Hoggard. 2016. Abundance of the coastal morphotype of bottlenose dolphin *Tursiops truncatus*, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2017-03, 135 pp.

Garrison, L.P., K. Barry and W. Hoggard. 2017. The abundance of coastal morphotype bottlenose dolphins on the U.S. east coast: 2002-2016. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2017-01, 37 pp.

Gulak, S.J.B., M.S. Passerotti and J.K. Carlson. 2012. Catch and bycatch in U.S. Southeast gillnet fisheries, 2011. NOAA Tech. Memo. NMFS-SEFSC-629, 28 pp.

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 organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. Sci. Total Environ. 319:147–172.

Kenney, R.D. 1990. Bottlenose dolphins off the northeastern United States. pp. 369-386. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Klatsky, L.J., R.S. Wells and J.C. Sweeney. 2007. Offshore bottlenose dolphins (*Tursiops truncatus*): Movement and dive behavior near the Bermuda Pedestal. J. Mammal. 88:59–66.

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.

Laake, J.L. and D.L. Borchers. 2004. Methods for incomplete detection at distance zero. pp. 108-189. *In:* S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.) Advanced distance sampling. Oxford University Press, New York.

Lettrich, M.D., M.J. Asaro, D.L. Borggaard, D.M. Dick, R.B. Griffis, J.A. Litz, C.D. Orphanides, D.L. Palka, M.S. Soldevilla, B. Balmer, S. Chavez, D. Cholewiak, D. Claridge, R.Y. Ewing, K.L. Fazioli, D. Fertl, E.M. Fougeres, D. Gannon, L. Garrison, J. Gilbert, A. Gorgone, A. Hohn, S. Horstman, B. Josephson, R.D. Kenney, J.J. Kiszka, K. Maze-Foley, W. McFee, K.D. Mullin, K. Murray, D.E. Pendleton, J. Robbins, J.J. Roberts, G. Rodriguez-Ferrer, E. Ronje, P.E. Rosel, T. Speakman, J.E. Stanistreet, T. Stevens, M. Stolen, R. Tyson Moore, N.L. Vollmer, R. Wells, H.R. Whitehead and A. Whitt. 2023. Vulnerability to climate change of United States marine mammal stocks in the western North Atlantic, Gulf of Mexico, and Caribbean. PLoS ONE 18(9): e0290643.

Lipscomb, T.P., F.Y. Schulman, D. Moffett and S. Kennedy. 1994. Morbilliviral disease in Atlantic bottlenose dolphins (*Tursiops truncatus*) from the 1987–1988 epizootic. J. Wildl. Dis. 30:567–571.

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.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: A review and synthesis. Endang. Species Res. 7:125–136.

Mathers, A.N., B.M. Deacy, H.E. Moncrief-Cox and J.K. Carlson. 2020. Catch and bycatch in U.S. Southeast gillnet fisheries, 2018. NOAA Tech. Memo. NMFS-SEFSC-743. 15 pp.

Mathers, A.N., B.A. Smith, D.E. Jordan, J.K. Carlson, and S. Leach. 2024. Observer coverage of the Southeast U.S. Shark Bottom Longline and Gillnet Fisheries: 2019–2023. NOAA Tech. Memo. NMFS-SEFSC-787, 44 pp.

Maze-Foley, K. and L.P. Garrison. 2022. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2022-02. 69 pp. https://repository.library.noaa.gov/view/noaa/48483

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., J.S. Reif, M. Youngbluth, M.E. Murdoch, S.E. Bechdel, E. Howells, S.D. McCulloch, L.J. Hansen and G.D. Bossart. 2008. 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., M.E. Murdoch, J.S. Reif, S.E. Bechdel, E. Howells, M.de Sieyes, C. Lawrence, 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. Fla. Sci. 74:25–37.

Mead, J.G. and C.W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: Morphological and ecological considerations. IBI Reports 5:31–44.

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.

Neter, J., W. Wasserman and M. Kutner. 1983. Applied linear regression models. Richard D. Irwin, Inc., Homewood, Illinois. 547 pp.

NMFS. 2023. Guidelines for Preparing Stock Assessment Reports Pursuant to the Marine Mammal Protection Act. Protected Resources Policy Directive 02-204-01. https://www.fisheries.noaa.gov/s3/2023-05/02-204-01-Final-GAMMS-IV-Revisions-clean-1-kdr.pdf

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(4):819–832.

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.

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.

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. 21:2752–2764.

Schwacke, L.H., L. Thomas, R.S. Wells, W.E. McFee, A.A. Hohn, K.D. Mullin, E.S. Zolman, B.M. Quigley, T.K. Rowles and J.H. Schwacke. 2017. Quantifying injury to common bottlenose dolphins from the *Deepwater Horizon* oil spill using an age-, sex- and class-structured population model. Endanger. Spec. Res. 33:265–279.

Schwacke, L.H., T.A. Marques, L. Thomas, C.G. Booth, B.C. Balmer, A. Barratclough, K. Colegrove, S. De Guise, L.P. Garrison, F.M. Gomez, J.S. Morey, K.D. Mullin, B.M. Quigley, P.E. Rosel, T.K. Rowles, R. Takeshita, F.I. Townsend, T.R. Speakman, R.S. Wells, E.S. Zolman, and C.R. Smith. 2022. Modeling population effects of the Deepwater Horizon oil spill on a long-lived species. Conserv. Biol. 36(4):e13878. 13 pp.

Scott, G.P., D.M. Burn and L.J. Hansen. 1988. The dolphin die off: Long term effects and recovery of the population. Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8, Vol. 3:819–823. Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.

Spalding, M.D., H.E. Fox, G.R. Allen, N. Davidson, Z.A. Ferdaña, M. Finlayson, B.S. Halpern, M.A. Jorge, A. Lombana and S.A. Lourie. 2007. Marine ecoregions of the world: A bioregionalization of coastal and shelf areas. BioScience 57(7):573–583.

Speakman, T., E.S. 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, 243 pp.

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.

Thorne, L.H., E.I. Heywood and N.O. Hirtle. 2022. Rapid restructuring of the odontocete community in an ocean warming hotspot. Glob. Change Biol. 00:1–17.

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, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Waring, G.T., J.M. Quintal and C.P. Fairfield, eds. 2002. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments -- 2002. NOAA Tech. Memo. NMFS-NE-169, 318 pp.

Watanabe, M., K. Kannan, A. Takahashi, B.G. Loganathan, D.K. Odell, S. Tanabe and J.P. Giesy. 2000. Polychlorinated biphenyls, organochlorine pesticides, tris(4-chlorophenyl)methane, and tris(4-chlorophenyl)methanol in livers of small cetaceans stranded along Florida coastal waters, USA. Environ. Toxicol. Chem. 19:1566–1574.

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., V. Tornero, A. Borrell, A. Aguilar, T.K. Rowles, H.L. Rhinehart, S. Hofmann, W.M. Jarman, A.A. Hohn and J.C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349:106–119.

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

TAMANEND'S BOTTLENOSE DOLPHIN (*Tursiops erebennus*): Western North Atlantic Central Florida Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins, *Tursiops* spp., are found in estuarine, coastal, continental shelf, and oceanic waters of the western North Atlantic (wNA). Two species are found in the wNA off the U.S. East Coast: a smaller species, Tamanend's bottlenose dolphin (*Tursiops erebennus*, Costa et al. 2022), present in estuarine, coastal, and shelf waters from Florida to approximately Long Island, New York, and a larger, more robust species, common bottlenose dolphin (*Tursiops truncatus*), present farther offshore in deeper waters of the continental shelf and slope from Florida to Canada (Mead and Potter 1995). The two species also differ in parasite load and prey preferences (Mead and Potter 1995).

Spatial distribution data (Kenney 1990; Garrison et al. 2017), photo-identification (photo-ID) studies (e.g., Zolman 2002; Speakman et al. 2006; Stolen et al. 2007; Mazzoil et al. 2008), and genetic studies (Caldwell 2001; Rosel et al. 2009; Litz et al. 2012) indicate that *T. erebennus* comprises multiple stocks distributed in coastal and estuarine waters of the wNA. The Central Florida Coastal Stock is one such stock.

Tamanend's bottlenose dolphins are found in coastal waters south of Cape Hatteras, North Carolina, to southern Florida year-round (Blaylock and Hoggard 1994; Garrison and Yeung 2001; Garrison et al. 2016; Mazzoil et al. 2016; Caldwell 2016). Significant genetic differentiation was observed between animals sampled in coastal waters of Georgia and those sampled in the Jacksonville, Florida, area (Rosel et al. 2009), indicative of demographic independence between animals sampled in these two coastal regions. Similarly, genetic analyses of dolphins sampled in coastal and estuarine waters near the Indian River Lagoon, Florida, revealed significant differentiation (Richards et al. 2013). Photo-ID studies in both Jacksonville and in central Florida near the Indian River Lagoon also distinguished between dolphins that used coastal waters and those using estuarine waters (Mazzoil et al. 2011; Caldwell 2016), indicating the presence of demographically independent coastal and estuarine stocks along the Florida coast.

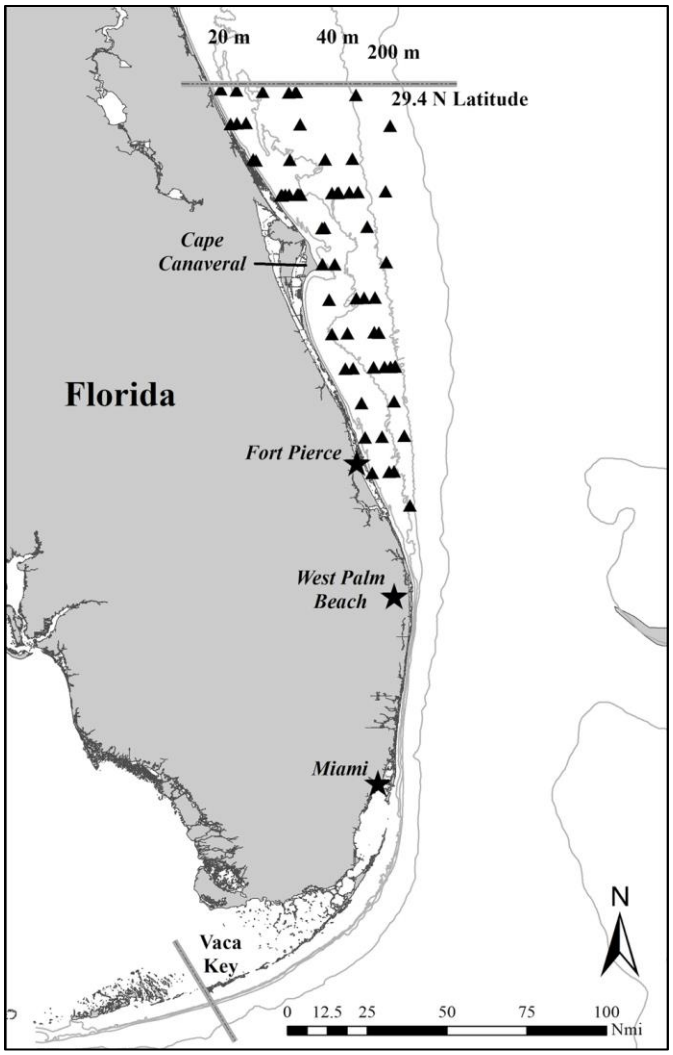


Figure 1. The Central Florida Coastal Stock of Tamanend's bottlenose dolphins (29.4°N to Vaca Key). Symbols represent all sightings of bottlenose dolphin groups from NMFS 2010, 2011, 2016, and 2021 aerial surveys within the boundaries of this stock. In waters >20 m, sightings may include the offshore species of bottlenose dolphins. Horizontal gray lines intersecting the coast denote the stock boundaries.

The Central Florida Coastal Stock includes Tamanend's bottlenose dolphins inhabiting coastal waters from the shoreline to the 200-m isobath from 29.4°N south to the western end of Vaca Key (~24.7°N, 81.1°W) where the stock

boundary for the Florida Keys Stock begins (Figure 1). The northern and southern boundaries for this stock are provisional as the spatial extent of this stock is poorly understood. The boundaries are derived from the first delimitation of coastal stocks in 2002 (Waring et al. 2002) when the original single, coast-wide coastal stock suggested by Scott et al. (1988) was broken into seven management units (Waring et al. 2002). The offshore boundary was determined based on a combined genetic and logistic regression analysis that incorporated depth, latitude, and distance from shore to model the probability that a particular bottlenose dolphin group seen in coastal waters south of Cape Hatteras was of the coastal morphotype (Garrison et al. 2017). Dolphins of the coastal morphotype, now *T. erebennus*, were identified in waters out to 97 m depth. The logistic regression predicted that the majority of Tamanend's bottlenose dolphins inhabit waters 0-20 m in depth and that their density declines with increasing depth (Garrison et al. 2017). South of Cape Hatteras in waters less than 20 m depth, 70% of the bottlenose dolphins were predicted to be of the coastal morphotype and fewer than 10% of the animals present beyond 35 m depth were predicted to be of the coastal morphotype (Garrison et al. 2017). These spatial patterns may not apply as well to the Central Florida Coastal Stock, however, as there is a significant change in the bathymetric slope and a close approach of the Gulf Stream to the shoreline south of Cape Canaveral.

It is plausible this stock contains multiple demographically independent populations because its range crosses a known biogeographic break at Cape Canaveral, Florida (Pelc et al. 2009), and appropriate coastal habitat is limited in southern Florida between West Palm Beach and Miami where the Gulf Stream comes close to shore. The lack of appropriate habitat in this region could serve as a barrier between members of this stock that inhabit coastal waters from Vaca Key eastward to approximately Miami, Florida, and those inhabiting coastal waters north of West Palm Beach where the shelf widens again.

There is no firm boundary defining the offshore extent of this stock and it overlaps to some degree with the Offshore Stock (Garrison et al. 2017). This spatiotemporal overlap complicates the ability to definitively identify the offshore extent for the stock and the assignment of human-caused dolphin mortalities to stock at certain times of the year.

POPULATION SIZE

The best available abundance estimate for the Northern Florida Coastal Stock of Tamanend's bottlenose dolphins in the western North Atlantic is 2,541 (CV=0.46; Tables 1 and 2; Garrison and Dias 2024). This estimate is derived from aerial surveys conducted during the summer of 2021 covering coastal and shelf waters from Florida to New Jersey.

Background

Estimating the abundance of the Central Florida Coastal Stock is complicated by the potential for the occasional presence, in nearshore coastal waters, of dolphins from estuarine stocks in Florida (Mazzoil et al. 2011; Caldwell 2016) as well as by possible spatiotemporal overlap with the wNA Offshore Stock of common bottlenose dolphins. Using the logistic regression described above (Garrison et al. 2017), abundance estimates for the Central Florida Coastal Stock were made using sightings observed in the 0-200 m depth stratum during summer aerial surveys between 29.4°N and Ft. Pierce, Florida (26.9°N). The regression model was used to estimate the probability that each sighting during the aerial survey is of the coastal (vs. offshore) morphotype, *T. erebennus*. This probability and associated estimates of uncertainty were then incorporated into the abundance estimate for the coastal morphotype within the stock range (Garrison et al. 2017). The area of coastline between Fort Pierce, Florida, and Vaca Key, which lies within this stock's boundary, was not surveyed and so the resulting abundance estimates are negatively biased.

Earlier abundance estimates)

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

Recent surveys and abundance estimates

The Southeast Fisheries Science Center conducted aerial surveys of continental shelf waters along the U.S. East Coast from southeastern Florida (26.9°N) to Cape May, New Jersey (40.3°N), during the summer of 2021 (Garrison and Dias 2024). The surveys were conducted along tracklines spaced latitudinally at 20-km intervals and oriented perpendicular to the shoreline, and covered waters from the shoreline to the continental shelf break (Garrison and Dias 2024).

As with previous surveys, the 2021 survey was conducted using a two-team approach to develop estimates of

detection probabilities using the independent observer approach with Distance analysis (Laake and Borchers 2004). The detection function indicated a decreased probability of detection near the trackline. The sighting data were therefore "left-truncated" by analyzing only sightings occurring greater than 75 m from the trackline (see Buckland et al. 2001 for left-truncation methodology). The independent observer method assuming point independence was used to estimate detection probability on the trackline. This estimate accounts for the probability of detecting a marine mammal group conditional on it being available to both survey teams. Covariates that may influence detection probabilities (e.g., sea state, glare, cloud cover, visibility) were incorporated into both the mark-recapture and distance function components of the detection models (Laake and Borchers 2004; Garrison and Dias 2024). The resulting abundance estimate is negatively biased due to the effects of animals spending some time underwater where they are not available to the survey teams. However, due to the relatively short dive times of bottlenose dolphins (Klatsky et al. 2007) and the large group sizes, it is likely that this bias is small (Garrison and Dias 2024).

The abundance estimate for the 2021 summer aerial survey was 2,541 (CV=0.46; Garrison and Dias 2024). Uncertainties in the abundance estimate arise primarily from annual, and unquantified, variation in stock distribution.

Table 1. Summary of abundance estimates for the western North Atlantic Central Florida Coastal Stock of Tamanend's bottlenose dolphins. Month, year, and area covered during each abundance survey, and resulting abundance estimate (Nest) and coefficient of variation (CV).

Month/Year	Area	Nest	CV
June-August 2021	29.4°N Latitude to Ft. Pierce, Florida (26.9°N)	2,541	0.46

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. The best estimate for the Central Florida Coastal Stock is 2,541 (CV=0.46). The resulting minimum population estimate is 1,760 (Table 2).

Current Population Trend

Available surveys allow a limited analysis of trend in population size for coastal stocks of Tamanend's bottlenose dolphins. A standardized analytical approach accounting for variation in survey execution and environmental conditions was used to derive unbiased abundance estimates for each survey (Garrison et al. 2017; Garrison and Dias 2024). A weighted generalized linear model was used to evaluate trends in population size by stock using abundance estimates from surveys conducted in the summers of 2002, 2004, 2010, 2011, 2016, and 2021. Abundance estimates were weighted by the inverse of their variance, which reduces the influence of less certain estimates (Neter et al. 1983). Stock was treated as a fixed factor, and surveys were grouped into four periods to test for long term trends in population size: 2002-2004, 2010-2011, 2016, and 2021. Period was also included as a fixed factor in the model along with the interaction between stock and period. Contrasts were specified to test for differences in abundance between periods for each stock (Garrison et al. 2017; Garrison and Dias 2024). For the Central Florida Coastal Stock, the resulting mean abundance estimate for 2002-2004 was 2,108 (CV=0.99), for 2010-2011 was 6,777 (CV=0.63), and for 2016 was 1,218 (CV=0.35). There was no significant difference between these estimates and the estimate of 2,541 (CV=0.46) for 2021. There is limited power to detect a significant change given the high CV of the estimates, interannual variability in spatial distribution and stock abundance between 2002 and 2004, and the limited number of surveys available (Garrison et al. 2017; Garrison and Dias 2024). However, see the Strandings section for a discussion of coast-wide trends in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for Tamanend's bottlenose dolphin. The maximum net productivity rate was assumed to be 0.03. This value is based on a population dynamics model showing that bottlenose dolphin populations in the Atlantic Ocean and Gulf of America may not grow at rates much greater than 3% given the constraints of their reproductive life history (Schwacke et al. 2017; 2022).

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; Wade 1998). The minimum population size of the Central Florida Coastal Stock of Tamanend's bottlenose dolphins is 1,760. The

maximum productivity rate is 0.03. The recovery factor is 0.5 because this stock is depleted. PBR for this stock of Tamanend's bottlenose dolphins is 13 (Table 2).

Table 2. Best and minimum abundance estimates for the western North Atlantic Central Florida Coastal Stock of Tamanend's bottlenose dolphins with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

Nest	CV Nest	Nmin	Fr	Rmax	PBR
2,541	0.46	1,760	0.5	0.03	13

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the Central Florida Coastal Stock during 2018-2022 is unknown. The mean annual fishery-related mortality and serious injury for strandings identified as fishery-related was 0. Mean annual mortality and serious injury due to other human-caused sources (vessel strike) was 0.2. Therefore, the minimum total mean annual human-caused mortality and serious injury for this stock during 2018-2022 was 0.2 (Table 2). This is a minimum estimate because 1) not all fisheries that could interact with this stock are observed, 2) stranding data are used as an indicator of fishery-related interactions and not all dead animals are detected and 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 includes a count of verified human-caused deaths and serious injuries and should be considered a minimum (NMFS 2016). In the sections below, dolphin mortalities were assigned to a stock or stocks by comparing the time and geographic location of the mortality to the stock boundaries and geographic range delimited for each stock.

Fishery Information

There are six commercial fisheries that interact, or that potentially could interact, with this stock. These include four Category II fisheries (Southeastern U.S. Atlantic shark gillnet, Southeast Atlantic gillnet, Atlantic blue crab trap/pot, and Southeastern U.S. Atlantic, Gulf of America stone crab trap/pot fisheries) and two Category III fisheries (Florida spiny lobster trap/pot, and the Atlantic Ocean, Gulf of America, Caribbean commercial passenger fishing vessel (hook and line) fisheries). 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), research takes, fisherman self-reported takes (through the Marine Mammal Authorization Program), and opportunistic at-sea observations.

Southeastern U.S. Atlantic Shark Gillnet and Southeast Atlantic Gillnet

There has been no documented mortality or serious injury of a Tamanend's bottlenose dolphin associated with the Southeastern U.S. Atlantic Shark Gillnet or Southeast Atlantic Gillnet fisheries during 2018-2022 that could be ascribed to the Central Florida Coastal Stock (Mathers et al. 2020; 2024). These fisheries target sharks and finfish in waters between North Carolina and southern Florida. The majority of fishing effort occurs in federal waters because Florida, Georgia, and South Carolina, with limited exceptions, prohibit the use of gillnets in state waters. These fisheries use gillnets set in a sink (anchored), stab, set, strike, or drift fashion. The Southeast Gillnet Observer Program observes these fisheries year-round (e.g., Mathers et al. 2020; 2024).

Trap/Pot

During 2018-2022, there was no documented mortality or serious injury in trap/pot gear that could be ascribed to the Central Florida Coastal Stock. The most recent documented mortality or serious injury due to trap/pot gear was from 2009. Because there is no systematic observer program, it is not possible to estimate the total mortality and serious injury associated with trap/pot gear. Stranding data indicate that mortality and serious injury due to interactions with trap/pot gear occur at some unknown level in North Carolina (Byrd et al. 2014) and other regions of the southeast U.S. (Noke and Odell 2002; Burdett and McFee 2004).

Hook and Line (Rod and Reel)

During 2018-2022, there was one mortality documented in the stranding data involving hook and line gear entanglement and/or ingestion that was ascribed to the Central Florida Coastal Stock. The mortality occurred in 2022. The available evidence from the stranding data suggested the hook and line gear did not contribute to the cause of death, and therefore, this animal was not included in the annual human-caused mortality and serious injury total for

this stock (Table 3).

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 animals killed or seriously injured by hook and line gear because there is no systematic observer program.

Other Mortality

During 2018-2022, there was one at-sea observation of a Tamanend's bottlenose dolphin with wounds from a vessel strike that was ascribed to the Central Florida Coastal Stock. The vessel strike occurred in 2020, and this animal was considered seriously injured (Maze-Foley and Garrison 2022) and is included within the annual human-caused mortality and serious injury total for this stock (Table 3).

Historically, there have been occasional mortalities of bottlenose dolphins during research activities (Waring et al. 2016); however, none were documented during 2018-2022 that could be ascribed to the Central Florida Coastal Stock.

All mortality and serious injury from known sources for the Central Florida Coastal Stock are summarized in Table 3.

Table 3. Summary of the incidental mortality and serious injury of Tamanend's bottlenose dolphins of the Central Florida Coastal Stock. For fisheries with an ongoing, systematic, federal observer program, the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortality and serious injury recorded by on-board observers, and mean annual mortality and serious injury are provided. For fisheries that do not have an ongoing, systematic, federal observer program, minimum counts of mortality and serious injury based on stranding data are given. See the Annual Human-Caused Mortality and Serious Injury section for biases and limitations of mortality estimates. NA = not applicable.

Fishery	Years	Data Type	Observer Coverage	Observed Mortality and Serious Injury	Mean Annual Mortality and Serious Injury Based on Observer Data	5-year Count Based on Stranding Data
Southeastern U.S. Atlantic Shark Gillnet	2018-2022	Obs. Data Logbook	NA due to uncertainty in reported effort	0,0,0,0,0	Not estimated	NA
Southeast Atlantic Gillnet	2018-2022	Obs. Data Logbook	NA due to uncertainty in reported effort	0,0,0,0,0	Not estimated	NA
Atlantic Blue Crab Trap/Pot	2018-2022	Stranding Data	NA	NA	NA	0
Hook and Linea	2018-2022	Stranding Data	NA	NA	NA	0
Mean Annual Mortality and Serious Injury due to commercial fisheries (2018-2022)					**0**	
Other Mortality and Serious Injury (vessel strike; 5-year Count)					1	
Mean Annual Mortality and Serious Injury due to other sources (2018-2022)					**0.2**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2018-2022)					**0.2**	

a Hook and line interactions are counted here if the available evidence suggested the hook and line gear contributed to the cause of death. See "Hook and Line" text for more details.

STATUS OF STOCK

Tamanend's bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act, but the Central Florida Coastal Stock is a strategic stock due to its designation as depleted under the MMPA. From 1995 to 2001, NMFS recognized only the western North Atlantic Coastal Stock of bottlenose dolphins in the western North Atlantic, and this stock was listed as depleted as a result of a UME in 1988-1989 (64 FR 17789, April 6, 1993). The stock structure was revised in 2008, 2009, and 2010, to recognize resident estuarine stocks and migratory and resident coastal stocks. The Central Florida Coastal Stock retains the depleted designation as a result of its origin from the western North Atlantic Coastal Stock. This stock is presumed to be below OSP due to its designation as depleted. PBR for the Central Florida Coastal Stock is 13, so the zero mortality rate goal, 10% of PBR, is 1.3. The documented total mean annual human-caused mortality for this stock for 2018-2022 was 0.2. However, this estimate is biased low for the following reasons: 1) there are several commercial fisheries operating within this stock's boundaries that have little to no observer coverage, and 2) the estimate incorporates a count of verified human-caused deaths and serious injuries and should be considered a minimum (NMFS 2023). Given these biases and uncertainties, there is insufficient information to determine whether or not the total fishery-related mortality and serious injury is approaching a zero mortality and serious injury rate. The impact to this stock of the 2013-2015 mid-Atlantic and the 2008 Indian River Lagoon UMEs is unknown. Analysis of trends in abundance suggests a possible decline in stock size between 2010-2011, and 2016. The 2021 abundance estimate is higher than that from 2016, but the estimates are not significantly different from each other. However, there is limited power to evaluate trends given uncertainty in stock distribution, lack of precision in abundance estimates, and a limited number of surveys.

OTHER FACTORS THAT MAY BE CAUSING A DECLINE OR IMPEDING RECOVERY

Strandings

During 2018-2022, 33 stranded bottlenose dolphins were recovered within the range of the Central Florida Coastal Stock (Table 4; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 14 July 2023). It could not be determined if there was evidence of human interactions for 15 of these strandings, and for 14 it was determined there was no evidence of human interaction. The remaining four showed evidence of human interactions, one of which was an interaction with hook and line fishing gear.

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.

This stock has been impacted by three unusual mortality events (UME). Two events, one in 1987-1988 and one in 2013-2015, were attributed to morbillivirus epidemics (Lipscomb et al. 1994; Morris et al. 2015). When the impacts of the 1987-1988 UME were being assessed, only a single coastal stock of bottlenose dolphin was thought to exist along the U.S. eastern seaboard from New York to Florida (Scott et al. 1988), so impacts to the Central Florida Coastal Stock alone are not known. However, it was estimated that between 10 and 50% of the coast-wide stock died as a result of this UME (Scott et al. 1988; Eguchi 2002). The total number of stranded bottlenose dolphins from New York through central Florida (Brevard County) during the 2013-2015 UME was ~1,827, including 319 from northern and central Florida (http://www.nmfs.noaa.gov/pr/health/mmume/midatldolphins2013.html, accessed 8 November 2016). The southern end of Brevard County was delimited as the southernmost range of the UME, so approximately one-third of the Central Florida Coastal Stock range is found within this UME area. Most strandings and morbillivirus positive animals have been recovered from the ocean side beaches rather than from within the estuaries, suggesting that coastal stocks have been more impacted by this UME than estuarine stocks (Morris et al. 2015).

Analysis of the coastwide trend in abundance for Tamanend's bottlenose dolphins from 2011 to 2021 suggests the population has returned to 2011 levels, after a period of decline during 2011-2016. An analysis of trends coast-wide (New Jersey to Florida) indicated a statistically significant decline in population size between 2011 and 2016 (Garrison et al. 2017). A weighted generalized linear model was used to evaluate trends in coast-wide population size based on aerial surveys conducted between 2002 and 2016 (see Population Size above for survey descriptions). The

model included a linear term for survey year and an interaction term to test for a difference in slope between 2002-2011 and 2011-2016. Estimates were weighted by the inverse of their variance to reduce the influence of less certain estimates. There was no significant trend in population size between 2002 and 2011; however, there was a statistically significant (p=0.0308) change in slope between 2011 and 2016, indicating a decline in population size. Extending this analysis with the coast-wide estimate from 2021 suggests increasing coast-wide abundance since 2016 (Garrison and Dias 2024). The coast-wide inverse-variance weighted average estimate for coastal Tamanend's bottlenose dolphins during 2011 was 41,456 (CV=0.30) while the estimate during 2016 was 19,470 (CV=0.23; Garrison et al. 2017), and the estimate for 2021 was 32,523 (CV=0.23; Garrison and Dias 2024). It is possible that the apparent decline in Tamanend's bottlenose dolphin abundance in coastal waters along the eastern seaboard was a result of the 2013–2015 UME. Finally, a UME was also declared for the Indian River Lagoon, Florida, area from May to August 2008 and one dolphin from the Central Florida Coastal Stock was considered to be part of this UME (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 13 September 2012). The cause of this UME was undetermined.

Table 4. Strandings of Tamanend's bottlenose dolphins during 2018–2022 that were ascribed to the Central Florida Coastal Stock, 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. Assignments to stock were based upon the understanding of the seasonal movements of the coastal stocks. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 14 July 2023). Please note HI does not necessarily mean the interaction caused the animal's death.

State	**2018**			**2019**			**2020**			**2021**			**2022**		
Type	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
Central Florida Coastal Stock	0	2	5	0	3	2	1	3	1	2	2	4	1	4	3
Annual Total	7			5			5			8			8		

[a] A fisheries interaction which involved hook and line gear entanglement and/or ingestion (mortality).

Habitat Issues

The nearshore and estuarine habitats occupied by Tamanend's bottlenose dolphins are adjacent to areas of high human population and some are highly industrialized. Studies have examined persistent organic pollutant concentrations in bottlenose dolphins inhabiting estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly near Brunswick, Georgia, Charleston, South Carolina, and Beaufort, North Carolina (Hansen et al. 2004; Balmer et al. 2011; Kucklick et al. 2011). Watanabe et al. (2000) also found high concentrations of PCBs and other organochlorine pesticides in livers of six dead, stranded dolphins collected along the Atlantic coast of Florida. The concentrations found in male dolphins from some sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke et al. 2002; Hansen et al. 2004; Balmer et al. 2011). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells et al. 2005). The exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

Changes in spatial distribution and abundance in response to long-term environmental changes, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Pinsky et al. 2013; Poloczanska et al. 2013; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019; Chavez-Rosales et al. 2022; Thorne et al. 2022). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat/environmental factors. Results varied by season

and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys between 2010 and 2017. During this time frame, the weighted centroid of the common bottlenose dolphin (including both coastal and offshore stocks) core habitat moved towards the northeast in all seasons, where the farthest was during fall (753 km) and the least was during winter (211 km). In addition, an assessment was conducted for the western North Atlantic non-migratory coastal stocks, which included the Central Florida Coastal Stock, to estimate vulnerability to environmental change (Lettrich et al. 2023). The stock was categorized with a vulnerability index resulting from assessments of sensitivity (ability to tolerate and adapt to environmental change) and exposure (projected change in environmental conditions). The non-migratory coastal stocks had an overall rank of "high" vulnerability to long-term environmental change (Lettrich et al. 2023).

REFERENCES CITED

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.

Blaylock, R.A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo. NMFS-SEFSC-356, 10 pp.

Buckland, S. T., D. R. Andersen, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, New York, 432 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.

Caldwell, M. 2016. 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.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580.

Costa, A., W. Mcfee, L. Wilcox, F. Archer, and P. Rosel. 2022. The common bottlenose dolphin (*Tursiops truncatus*) ecotypes of the western North Atlantic revisited: an integrative taxonomic investigation supports the presence of distinct species. Zool. J. Linn. Soc. 196:1608–1636.

Eguchi, T. 2002. A method for calculating the effect of a die-off from stranding data. Mar. Mamm. Sci. 18(3):698–709.

Garrison, L.P. and C. Yeung. 2001. Abundance estimates for Atlantic bottlenose dolphin stocks during summer and winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L.P. and L.A. Dias. 2024. Abundance of Tamanend's bottlenose dolphins (*Tursiops erebennus*) along the U.S. Atlantic Coast from aerial surveys conducted during summer 2021. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2024-04. 25 pp.

Garrison, L.P., P.E. Rosel, A.A. Hohn, R. Baird and W. Hoggard. 2016. Abundance of the coastal morphotype of bottlenose dolphin *Tursiops truncatus*, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2017-03, 135 pp.

Garrison, L.P., K. Barry, and W. Hoggard. 2017. The abundance of coastal morphotype bottlenose dolphins on the U.S. east coast: 2002-2016. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2017-01, XX pp.

Gulak, S.J.B., M.S. Passerotti and J.K. Carlson. 2012. Catch and bycatch in U.S. Southeast gillnet fisheries, 2011. NOAA Tech. Memo. NMFS-SEFSC-629, 28 pp.

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 organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. Sci. Total Environ. 319:147–172.

Kenney, R.D. 1990. Bottlenose dolphins off the northeastern United States. pp. 369-386. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Klatsky, L.J., R.S. Wells and J.C. Sweeney. 2007. Offshore bottlenose dolphins (*Tursiops truncatus*): Movement and dive behavior near the Bermuda Pedestal. J. Mammal. 88:59–66.

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.

Laake, J.L. and D.L. Borchers. 2004. Methods for incomplete detection at distance zero. pp. 108-189. *In:* S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.) Advanced distance sampling. Oxford University Press, New York.

Lettrich, M.D., M.J. Asaro, D.L. Borggaard, D.M. Dick, R.B. Griffis, J.A. Litz, C.D. Orphanides, D.L. Palka, M.S. Soldevilla, B. Balmer, S. Chavez, D. Cholewiak, D. Claridge, R.Y. Ewing, K.L. Fazioli, D. Fertl, E.M. Fougeres, D. Gannon, L. Garrison, J. Gilbert, A. Gorgone, A. Hohn, S. Horstman, B. Josephson, R.D. Kenney, J.J. Kiszka, K. Maze-Foley, W. McFee, K.D. Mullin, K. Murray, D.E. Pendleton, J. Robbins, J.J. Roberts, G. Rodriguez-Ferrer, E. Ronje, P.E. Rosel, T. Speakman, J.E. Stanistreet, T. Stevens, M. Stolen, R. Tyson Moore, N.L. Vollmer, R. Wells, H.R. Whitehead and A. Whitt. 2023. Vulnerability to climate change of United States marine mammal stocks in the western North Atlantic, Gulf of Mexico, and Caribbean. PLoS ONE 18(9): e0290643.

Lipscomb, T.P., F.Y. Schulman, D. Moffett and S. Kennedy. 1994. Morbilliviral disease in Atlantic bottlenose dolphins (*Tursiops truncatus*) from the 1987–1988 epizootic. J. Wildl. Dis. 30:567–571.

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.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: A review and synthesis. Endang. Species Res. 7:125–136.

Mathers, A.N., B.M. Deacy, H.E. Moncrief-Cox and J.K. Carlson. 2020. Catch and bycatch in U.S. Southeast gillnet fisheries, 2018. NOAA Tech. Memo. NMFS-SEFSC-743. 15 pp.

Mathers, A.N., B.A. Smith, D.E. Jordan, J.K. Carlson, and S. Leach. 2024. Observer coverage of the Southeast U.S. Shark Bottom Longline and Gillnet Fisheries: 2019-2023. NOAA Tech. Memo. NMFS-SEFSC-787, 44 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. 2022. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2022-02. 69 pp. https://repository.library.noaa.gov/view/noaa/48483

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. 2008. 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., M.E. Murdoch, J.S. Reif, S.E. Bechdel, E. Howells, M.de Sieyes, C. Lawrence, 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. Fla. Sci. 74:25–37.

Mead, J.G. and C.W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: Morphological and ecological considerations. IBI Reports 5:31–44.

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.

Neter, J., W. Wasserman and M. Kutner. 1983. Applied linear regression models. Richard D. Irwin, Inc., Homewood, Illinois. 547 pp.

NMFS. 2023. Guidelines for Preparing Stock Assessment Reports Pursuant to the Marine Mammal Protection Act. Protected Resources Policy Directive 02-204-01. https://www.fisheries.noaa.gov/s3/2023-05/02-204-01-Final-GAMMS-IV-Revisions-clean-1-kdr.pdf

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(4):819–832.

Pelc, R.A., R.R. Warner and S.D. Gaines. 2009. Geographical patterns of genetic structure in marine species with contrasting life histories. J. Biogeogr. 36(10):1881–1890.

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.

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.

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. 21:2752–2764.

Schwacke, L.H., L. Thomas, R.S. Wells, W.E. McFee, A.A. Hohn, K.D. Mullin, E.S. Zolman, B.M. Quigley, T.K. Rowles and J.H. Schwacke. 2017. Quantifying injury to common bottlenose dolphins from the *Deepwater Horizon* oil spill using an age-, sex- and class-structured population model. Endanger. Spec. Res. 33:265–279.

Schwacke, L.H., T.A. Marques, L. Thomas, C.G. Booth, B.C. Balmer, A. Barratclough, K. Colegrove, S. De Guise, L.P. Garrison, F.M. Gomez, J.S. Morey, K.D. Mullin, B.M. Quigley, P.E. Rosel, T.K. Rowles, R. Takeshita, F.I. Townsend, T.R. Speakman, R.S. Wells, E.S. Zolman, and C.R. Smith. 2022. Modeling population effects of the Deepwater Horizon oil spill on a long-lived species. Conserv. Biol. 36(4):e13878. 13 pp.

Scott, G.P., D.M. Burn and L.J. Hansen. 1988. The dolphin die off: Long term effects and recovery of the population. Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8, Vol. 3:819–823. Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.

Speakman, T., E.S. 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, 243 pp.

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.

Thorne, L.H., E.I. Heywood and N.O. Hirtle. 2022. Rapid restructuring of the odontocete community in an ocean warming hotspot. Glob. Change Biol. 00:1–17.

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, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Waring, G.T., J.M. Quintal and C.P. Fairfield, eds. 2002. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments -- 2002. NOAA Tech. Memo. NMFS-NE-169, 318 pp.

Waring, G.T., E. Josephson, K. Maze-Foley and P.E. Rosel. 2016. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2015. NOAA Tech. Memo. NMFS-NE-238, 512 pp.

Watanabe, M., K. Kannan, A. Takahashi, B.G. Loganathan, D.K. Odell, S. Tanabe and J.P. Giesy. 2000. Polychlorinated biphenyls, organochlorine pesticides, tris(4-chlorophenyl)methane, and tris(4-chlorophenyl)methanol in livers of small cetaceans stranded along Florida coastal waters, USA. Environ. Toxicol. Chem. 19:1566–1574.

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., V. Tornero, A. Borrell, A. Aguilar, T.K. Rowles, H.L. Rhinehart, S. Hofmann, W.M. Jarman, A.A. Hohn and J.C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349:106–119.

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

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*) Biscayne Bay Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins, *Tursiops* spp., are found in estuarine, coastal, continental shelf, and oceanic waters of the western North Atlantic (wNA). Two species are found in the wNA off the U.S. East Coast: a smaller species, Tamanend's bottlenose dolphin (*Tursiops erebennus*, Costa et al. 2022), present in estuarine, coastal, and shelf waters from Florida to approximately Long Island, New York, and a larger, more robust species, common bottlenose dolphin (*Tursiops truncatus*), present farther offshore in deeper waters of the continental shelf and slope from Florida to Canada (Mead and Potter 1995). The research conducted by Costa et al. (2022) describing *Tursiops erebennus* did not include samples as far south as Biscayne Bay. Therefore, the status of the Biscayne Bay Stock with regards to other *Tursiops* species or subspecies is uncertain. For the present, we are retaining the *Tursiops truncatus* species status for the Biscayne Bay Stock, but this may change in the future pending the results of additional research.

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 America coast (Wells et al. 1987; Sellas et al. 2005; Balmer et al. 2008; Rosel et al. 2017).

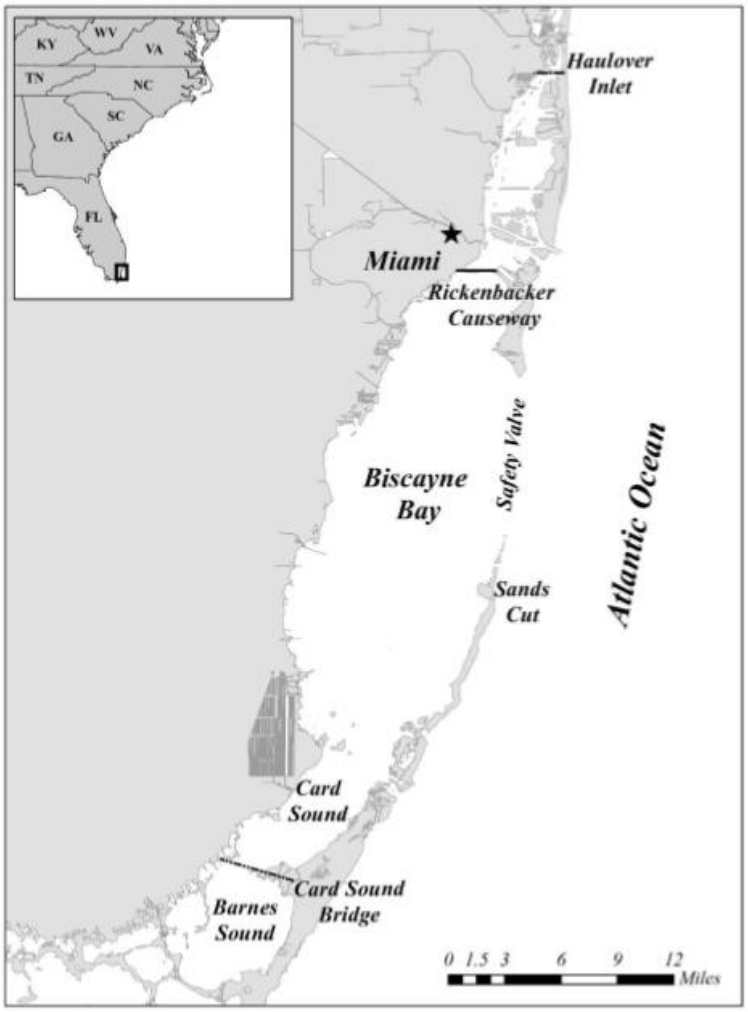


Figure 1. ***Geographic extent of the Biscayne Bay Stock. Dashed lines at Haulover Inlet and Card Sound Bridge denote the boundaries.***

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.

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 (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. Many of these individuals are long-term residents with multiple sightings over the course of the study (Litz et al. 2012). 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 from microsatellite data but not from 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 site fidelity observed, demonstrate that the resident Biscayne Bay common bottlenose dolphins are a demographically independent population. 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 (Litz 2007) 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.

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 2018-2022, there were two stranded bottlenose dolphins in unassigned estuarine habitat north of the Biscayne Bay Stock. There was evidence of human interaction for one of the strandings in the form of healed fishery interaction marks.

POPULATION SIZE

The best available abundance estimate for the Biscayne Bay Stock of common bottlenose dolphins is 241 (95% CI:224-261; CV=0.04; Table 1), based on a fall (October–November) 2019 vessel-based capture-recapture photo-ID survey (Bowers et al. 2024).

Recent surveys and abundance estimates

Bowers et al. (2024) conducted vessel-based capture-recapture photo-ID surveys during 2019 to estimate abundance of common bottlenose dolphins of the Biscayne Bay Stock. Using Pollock's "Robust" capture-mark-recapture (CMR) survey design (Pollock 1982) and following methods described by Rosel et al. (2011), a primary sampling session was conducted during October–November 2019 that included three secondary surveys. Surveys followed predetermined tracklines which split the bay into northern and southern regions. When possible, two research vessels operated simultaneously to allow sampling of both northern and southern portions of the bay within a single day, and when not possible, one vessel sampled the northern half followed by the southern half on the next day, weather conditions permitting. Using mark-resight models in R (R core Team 2022), CMR data were analyzed using the RMark package (Laake 2013) and the software program MARK version 8.2 (http://www.phidot.org/software/mark/index.html). Using the zero-inflated Poisson log-normal mark-resight model

(ziPNE) (McClintock et al. 2019), the best estimate of abundance was 241 (95% CI:224-261; CV=0.04; Table 1; Bowers et al. 2024).

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 Biscayne Bay Stock is 241 (95% CI:224-261; CV=0.04). The resulting minimum population estimate is 233 (Table 1).

Current Population Trend

Population trends for this stock have not been analyzed.

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 0.03. This value is based on a population dynamics model showing that bottlenose dolphin populations in the Atlantic Ocean and Gulf of America may not grow at rates much greater than 3% given the constraints of their reproductive life history (Schwacke et al. 2017; 2022).

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 233. The maximum productivity rate is 0.03. 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 1.7 (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	Nmin	Fr	Rmax	PBR
241	0.04	233	0.5	0.03	1.7

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the Biscayne Bay Stock during 2018-2022 is unknown. The mean annual fishery-related mortality and serious injury during 2018-2022 based on strandings and at-sea observations identified as fishery-related was 0.6. Additional mean annual mortality and serious injury during 2018-2022 due to other human-caused sources was 0.4 (illegal or derelict gear, vessel strike). The minimum total mean annual human-caused mortality and serious injury for this stock during 2018-2022 was therefore 1.0 (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 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 2023), 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).

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 America 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 America, 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.

Trap/Pot

During 2018-2022 there were two documented entanglement serious injuries of common bottlenose dolphins in Biscayne Bay with 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 2022). 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 14 July 2023).

Since there is no observer program, it is not possible to estimate the total number of mortality and serious injury associated with these crab trap/pot fisheries. The documented serious injuries in this gear represent a minimum known count of mortality and serious injury in the last five years.

Hook and Line (Rod and Reel)

During 2018-2022 within the Biscayne Bay area, there was one documented mortality of a common bottlenose dolphin with ingested hook and line fishing gear. During 2018, there was one mortality where 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 14 July 2023).

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 mortality and serious injury with hook and line gear because there is no observer program. The documented mortality in this gear represents a minimum known count of mortality and serious injury in the last five years.

Other Mortality

During 2018-2022 there was one documented entanglement serious injury of a common bottlenose dolphin in Biscayne Bay with gillnet gear. During 2021, one animal was released alive, and it was considered seriously injured following mitigation efforts (Maze-Foley and Garrison 2024). This case is included in the annual human-caused mortality and serious injury total for this stock (Table 2) and within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 14 July 2023). Gillnet fishing is prohibited in Florida state waters, so it is unknown whether the entanglement involved illegal gear, or if derelict gear drifted into the bay from offshore waters and resulted in an entanglement.

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 14 July 2023).

All mortality and serious injury 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	2018-2022	Stranding Data and At-Sea Observations	NA	1
Unidentified Trap/Pot	2018-2022	Stranding Data and At-Sea Observations	NA	1
Hook and Line	2018-2022	Stranding Data and At-Sea Observations	NA	1
Mean Annual Mortality due to commercial fisheries (2018-2022)			**0.6**	
Other Mortality and Serious Injury (illegal or derelict gear, vessel strike; 5-year Count)			2	
Mean Annual Mortality due to other sources (2018-2022)			**0.4**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2018-2022)			**1.0**	

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. The documented mean annual human-caused mortality and serious injury for the Biscayne Bay Stock for 2018-2022 was 1.0, but this estimate is based on incomplete information and is likely biased low as indicated above (see Annual Human-Caused Mortality and Serious Injury section). Thus, determining whether human-caused mortality and serious injury is greater than PBR requires evaluation of the best available scientific information, including relevant information from other stocks (NMFS 2023). Wells et al. (2015) estimated that the proportion of common bottlenose dolphin carcasses recovered in Sarasota Bay, a relatively more open and urbanized estuarine environment, was 0.33, indicating significantly more mortalities occur than are recovered. For a less developed area consisting of a more complex salt marsh habitat, the Barataria Bay Estuarine System, the estimated proportion of common bottlenose dolphin carcasses recovered was 0.16 (DWH MMIQT 2015). Of these two studies, the Sarasota Bay recovery rate may be most appropriate for the Biscayne Bay Stock given that much of the habitat is urban and relatively open. Regardless, both studies strongly suggest that estimates of Atlantic bottlenose dolphin mortality based solely on observed strandings and/or at sea observations represent a small fraction of the actual mortality, somewhere between one third to one sixth. Given this, the annual

human-caused mortality and serious injury for the Biscayne Bay stock is very likely greater than its PBR of 1.7, so this stock is considered strategic. Total U.S. fishery-related mortality and serious injury for this stock is unknown, but at a minimum is greater than 10% of the PBR and, therefore, cannot be considered insignificant and approaching a zero mortality and serious injury rate. There is also 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. Population trends for this stock have not been analyzed.

OTHER FACTORS THAT MAY BE CAUSING A DECLINE OR IMPEDING RECOVERY

Strandings

During 2018-2022, nine common bottlenose dolphins were reported stranded within Biscayne Bay (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 14 July 2023). There was evidence of human interaction for five of the strandings. For the remaining four 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, gillnet 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.

Table 3. Common bottlenose dolphin strandings occurring in the Biscayne Bay Stock area from 2018 to 2022, 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 14 July 2023). Please note HI does not necessarily mean the interaction caused the animal's death.

Stock	Category	2018	2019	2020	2021	2022	Total
Biscayne Bay Stock	Total Stranded	2	1	3	2	1	9
	HI--Yes	2[a]	0	2[b]	1c	0	5
	HI--No	0	0	0	0	0	0
	HI--CBD	0	1	1	1	1	4

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).
c. An entanglement interaction with gillnet gear (released alive, could not be determined if seriously injured following mitigation).

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. 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 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 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).

Changes in spatial distribution and abundance in response to long-term environmental changes, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Pinsky et al. 2013; Poloczanska et al. 2013; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019; Chavez-Rosales et al. 2022; Thorne et al. 2022). There is uncertainty in how, if at all, the distribution and population size of this species will respond to long-term environmental changes and how any ecological shifts will affect human impacts to the species. An assessment was conducted for this stock to estimate vulnerability to environmental change (Lettrich et al. 2023). The stock was categorized with a vulnerability index resulting based on sensitivity (ability to tolerate and adapt to environmental change) and exposure (projected change in environmental conditions). The Biscayne Bay Stock had an overall rank of “very high” vulnerability to long-term environmental change (Lettrich et al. 2023).

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

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

Bowers, M., A. Brossard, J. Wicker, J. Litz and L. Garrison. 2024. Biscayne Bay, Florida common bottlenose dolphin abundance estimate: 2019. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2024-03. 12 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.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580.

DWH MMIQT [Deepwater Horizon Marine Mammal Injury Quantification Team]. 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.

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.

Laake, J.L. 2013. RMark: An R Interface for analysis of capture-recapture data with MARK. AFSC Processed Rep. 2013-01, 25 pp. Alaska Fisheries Science Center, NOAA, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115. https://repository.library.noaa.gov/view/noaa/4372

Lettrich, M.D., M.J. Asaro, D.L. Borggaard, D.M. Dick, R.B. Griffis, J.A. Litz, C.D. Orphanides, D.L. Palka, M.S. Soldevilla, B. Balmer, S. Chavez, D. Cholewiak, D. Claridge, R.Y. Ewing, K.L. Fazioli, D. Fertl, E.M. Fougeres, D. Gannon, L. Garrison, J. Gilbert, A. Gorgone, A. Hohn, S. Horstman, B. Josephson, R.D. Kenney, J.J. Kiszka, K. Maze-Foley, W. McFee, K.D. Mullin, K. Murray, D.E. Pendleton, J. Robbins, J.J. Roberts, G. Rodriguez-Ferrer, E. Ronje, P.E. Rosel, T. Speakman, J.E. Stanistreet, T. Stevens, M. Stolen, R. Tyson Moore, N.L. Vollmer, R. Wells, H.R. Whitehead and A. Whitt. 2023. Vulnerability to climate change of United States marine mammal stocks in the western North Atlantic, Gulf of Mexico, and Caribbean. PLoS ONE 18(9): e0290643.

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.MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: A review and synthesis. Endang. Species Res. 7:125–136.

Maze-Foley, K. and L.P. Garrison. 2022. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2016–2020. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia

Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2022-02. 69 pp. https://repository.library.noaa.gov/view/noaa/48483

Maze-Foley, K. and L.P. Garrison. 2024. Serious injury determinations for small cetaceans off the southeast U.S. coast, 2018–2022. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2024-08. 69 pp. https://repository.library.noaa.gov/view/noaa/61602

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 Tech. Memo. NMFS-SEFSC-742. 42 pp. Accessible at: 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.McClintock, B.T., G.C. White and M.A. Pryde. 2019. Improved methods for estimating abundance and related demographic parameters from mark-resight data. Biometrics 75(3):799–809.

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.

NMFS. 2023. Guidelines for Preparing Stock Assessment Reports Pursuant to the Marine Mammal Protection Act. Protected Resources Policy Directive 02-204-01. https://www.fisheries.noaa.gov/s3/2023-05/02-204-01-Final-GAMMS-IV-Revisions-clean-1-kdr.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.Pollock K.H. 1982. A capture-recapture design robust to unequal probability of capture. J. Wildl. Manag. 46:757–760.

R Core Team. 2022. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna. https://www.R-project.org

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., K.D. Mullin, L. Garrison, L. Schwacke, J. Adams, B. Balmer, P. Conn, M.J. Conroy, T. Eguchi, A. Gorgone, A. Hohn, M. Mazzoil, C. Schwartz, C. Sinclair, T. Speakman, K. Urian, N. Vollmer, P. Wade, R. Wells and E. Zolman. 2011. Photo-identification Capture-Mark-Recapture Techniques for Estimating Abundance of Bay, Sound and Estuary Populations of Bottlenose Dolphins along the U.S. East Coast and Gulf of Mexico: A Workshop Report. NOAA Tech. Memo. NMFS-SEFSC-621. 30 pp. https://repository.library.noaa.gov/view/noaa/4014

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.

Schwacke, L.H., L. Thomas, R.S. Wells, W.E. McFee, A.A. Hohn, K.D. Mullin, E.S. Zolman, B.M. Quigley, T.K. Rowles and J.H. Schwacke. 2017. Quantifying injury to common bottlenose dolphins from the *Deepwater Horizon* oil spill using an age-, sex- and class-structured population model. Endanger. Spec. Res. 33:265–279.

Schwacke, L.H., T.A. Marques, L. Thomas, C.G. Booth, B.C. Balmer, A. Barratclough, K. Colegrove, S. De Guise, L.P. Garrison, F.M. Gomez, J.S. Morey, K.D. Mullin, B.M. Quigley, P.E. Rosel, T.K. Rowles, R. Takeshita, F.I. Townsend, T.R. Speakman, R.S. Wells, E.S. Zolman, and C.R. Smith. 2022. Modeling population effects of the Deepwater Horizon oil spill on a long-lived species. Conserv. Biol. 36(4):e13878. 13 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. Conservation Genetics 6(5):715–728.Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.

Thorne, L.H., E.I. Heywood and N.O. Hirtle. 2022. Rapid restructuring of the odontocete community in an ocean warming hotspot. Glob. Change Biol. 00:1-17.

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., 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. 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.

HARBOR PORPOISE (*Phocoena phocoena phocoena*): Gulf of Maine/Bay of Fundy Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

This stock is a transboundary stock found in U.S. and Canadian Atlantic waters (Figure 1). The distribution of harbor porpoises has been documented by sighting surveys, satellite telemetry data, passive acoustic monitoring, strandings and takes reported by NMFS observers in the Sea Sampling Programs. During summer (July to September), harbor porpoises are concentrated in the northern Gulf of Maine, southern Bay of Fundy and around the southern tip of Nova Scotia, generally in waters less than 150 m deep (Gaskin 1977; Kraus et al. 1983; Palka 1995), with lower densities in the upper Bay of Fundy and on Georges Bank and farther south (Palka 2000). During fall (October–December) and spring (April–June), harbor porpoises are widely dispersed, mostly from New Jersey to Maine, with lower densities farther north and south. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada. In non-summer months they have been seen from the coastline to deep waters (>1,800 m; Westgate et al. 1998), although the majority are found over the continental shelf. Confirming these spatiotemporal patterns, recent passive acoustic monitoring offshore of Maryland detected harbor porpoises regularly during January–May 2014-2016 (Wingfield et al. 2017), monitoring south of Rhode Island detected harbor porpoises regularly during October-June 2020-2022, and monitoring in the Gulf of Maine detected a presence of harbor porpoise year-round during 2020-2022 (Holdman et al. 2023). There does not appear to be a temporally coordinated migration or a specific narrow migratory route to and from the Bay of Fundy region. However, several satellite-tagged harbor porpoises during the fall, favored the waters around the 92-m isobath, which is consistent with observations of high rates of incidental catches in this depth range (Read and Westgate 1997). There were two stranding records from Florida during the 1980s (Smithsonian strandings database) and one in 2003 (NE Regional Office/NMFS strandings and entanglement database).

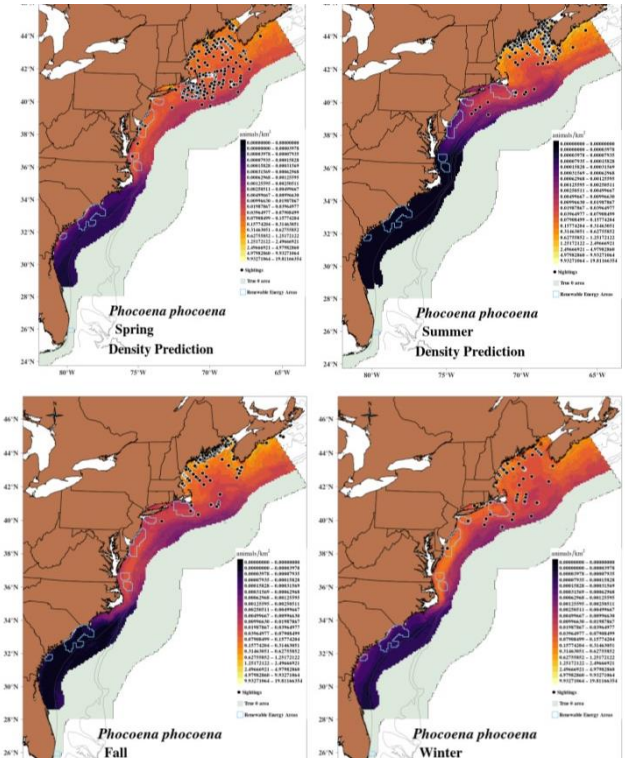


Figure 1. Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, 2011, 2016, and 2021 and portions of DFO's 2007 TNASS and 2016 NAISS surveys. Circle symbols represent shipboard sightings and squares are aerial sightings. Shaded area represents approximate stock range.

Gaskin (1984, 1992) proposed that there were four separate populations in the western North Atlantic: the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland populations. Analyses involving

mtDNA (Wang et al. 1996; Rosel et al. 1999a, 1999b), organochlorine contaminants (Westgate et al. 1997; Westgate and Tolley 1999), heavy metals (Johnston 1995), and life history parameters (Read and Hohn 1995) support Gaskin's proposal. Genetic studies using mitochondrial DNA (Rosel et al. 1999a) and contaminant studies using total PCBs (Westgate and Tolley 1999) indicate that the Gulf of Maine/Bay of Fundy females were distinct from females from the other populations in the Northwest Atlantic. Gulf of Maine/Bay of Fundy males were distinct from Newfoundland and Greenland males, but not from Gulf of St. Lawrence males according to studies comparing mtDNA (Palka et al. 1996; Rosel et al. 1999a) and CHLORs, DDTs, PCBs and CHBs (Westgate and Tolley 1999). Nuclear microsatellite markers have also been applied to samples from these four populations, but this analysis failed to detect significant population sub-division in either sex (Rosel et al. 1999a). These patterns may be indicative of female philopatry coupled with dispersal of males. Both mitochondrial DNA and microsatellite analyses indicate that the Gulf of Maine/Bay of Fundy stock is not the sole contributor to the aggregation of porpoises found off the mid-Atlantic states during winter (Rosel et al. 1999a; Hiltunen 2006). Mixed-stock analyses using twelve microsatellite loci in both Bayesian and likelihood frameworks indicate that the Gulf of Maine/Bay of Fundy is the largest contributor (~60%), followed by Newfoundland (~25%) and then the Gulf of St. Lawrence (~12%), with Greenland making a small contribution (<3%). For Greenland, the lower confidence interval of the likelihood analysis includes zero. For the Bayesian analysis, the lower 2.5% posterior quantiles include zero for both Greenland and the Gulf of St. Lawrence. Intervals that reach zero provide the possibility that these populations contribute no animals to the mid-Atlantic aggregation.

This report follows Gaskin's hypothesis on harbor porpoise stock structure in the western North Atlantic, where the Gulf of Maine and Bay of Fundy harbor porpoises are recognized as a single management stock separate from harbor porpoise populations in the Gulf of St. Lawrence, Newfoundland, and Greenland. It is unlikely that the Gulf of Maine/Bay of Fundy harbor porpoise stock contains multiple demographically independent populations (Rosel et al. 1999a; Hiltunen 2006), but a comparison of samples from the Scotian shelf to the Gulf of Maine has not yet been made.

POPULATION SIZE

The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock was generated from the 2021 NEFSC and SEFSC surveys that covered U.S. and Canadian waters, from Florida to Nova Scotia, Canada: 85,765 (CV=0.53; Table 1; Garrison and Dias 2023; Palka 2023). A key uncertainty in the population size estimate is the precision and accuracy of the availability bias correction factor that was applied. More information on the spatio-temporal variability of the animals' dive profile is needed.

Recent Surveys and Abundance Estimates

The recent abundance estimate of 85,765 (CV=0.53) harbor porpoises was generated from an aerial survey conducted in U.S. and Canadian waters of the western North Atlantic during the summer of 2021 (Table 1; Garrison and Dias 2023; Palka 2023). The aerial survey was conducted during summer in waters north of 38ºN in the Gulf of Maine to the lower Bay of Fundy and consisted of 5,217 km of on-effort primary tracklines. In addition, two vessel surveys were conducted concurrently covering waters from the southern Gulf of Maine to Florida with 5,659 km of on-effort track lines. No harbor porpoises were detected during the vessel surveys that covered waters not typically used by harbor porpoises during the summer. All three surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and Borchers 2004). Mark-recapture distance sampling was used to estimate abundance that was then corrected for availability bias (animals missed due to dive patterns). These surveys missed a small portion of the Gulf of Maine/Bay of Fundy habitat that is on the western part of the Scotian Shelf (east of 65 degrees W, about 10% of the known habitat).

Table 1. Summary of recent abundance estimates for the Gulf of Maine/Bay of Fundy harbor porpoise (*Phocoena phocoena phocoena*) by month, year, and area covered during each abundance survey and the resulting abundance estimate (N_{est}) and coefficient of variation (CV). The estimate considered best is in bold font.

Month/Year	Area	N_{est}	CV
Jun–Aug 2021	New Jersey to lower Bay of Fundy	85,765	0.53
Jun–Aug 2021	Central Florida to New Jersey	0	-
Jun–Aug 2021	**Central Florida to lower Bay of Fundy (COMBINED)**	**85,765**	**0.53**

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the Gulf of Maine/Bay of Fundy harbor porpoises is 85,765 (CV=0.53). The minimum population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 56,420 (Table 2). This estimate is considered an underestimate because about 10% of the known habitat was not surveyed and thus, not included in the best estimate of abundance.

Current Population Trend

A trend analysis has not been conducted for this stock. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval. 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).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Several attempts have been made to estimate potential population growth rates. Barlow and Boveng (1991), who used a re-scaled human life table, estimated the upper bound of the annual potential growth rate to be 9.4%. Woodley and Read (1991) used a re-scaled Himalayan tahr life table to estimate a likely annual growth rate of 4%. In an attempt to estimate a potential population growth rate that incorporates many of the uncertainties in survivorship and reproduction, Caswell et al. (1998) used a Monte Carlo method to calculate a probability distribution of growth rates. The median potential annual rate of increase was approximately 10%, with a 90% confidence interval of 3–15%. This analysis underscored the considerable uncertainty that exists regarding the potential rate of increase in this population. Moore and Read (2008) conducted a Bayesian population modeling analysis to estimate the potential population growth of harbor porpoise in the absence of bycatch mortality. Their method used fertility data, in combination with age-at-death data from stranded animals and animals taken in gillnets, and was applied under two scenarios to correct for possible data bias associated with observed bycatch of calves. Demographic parameter estimates were 'model averaged' across these scenarios. The Bayesian posterior median estimate for potential natural growth rate was 0.046. This last, most recent, value will be the one used for the purpose of this assessment.

Key uncertainties in the estimate of the maximum net productivity rate for this stock were discussed in Moore and Read (2008), which included the assumption that the age structure is stable, and the lack of data to estimate the probability of survivorship to maximum age. The authors considered the effects of these uncertainties on the estimated potential natural growth rate to be minimal.

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of 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 is 56,420. The maximum productivity rate for this stock is 0.046. The recovery factor is 0.5 because stock's status relative to Optimum Sustainable Population (OSP) is unknown and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the Gulf of Maine/Bay of Fundy harbor porpoise in U.S. and Canadian waters to Nova Scotia is 649 (Table 2). This PBR is considered a slight underestimate since about 10% of the known habitat was not surveyed and thus, was not included in the Nest abundance estimate.

Table 2. Best and minimum abundance estimates for the Gulf of Maine/Bay of Fundy harbor porpoise (*Phocoena phocoena phocoena*) with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) and PBR.

N_{est}	CV	N_{min}	F_r	R_{max}	PBR
85,765	0.53	56,420	0.5	0.046	649

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual estimated average human-caused mortality and serious injury is 142 harbor porpoises per year (CV=0.11) from U.S. fisheries using observer data and an annual average of 0.2 animals from non-fishery stranding records (Table 3). Canadian bycatch information is not available. This total annual estimated average human-caused

mortality and serious injury is considered an underestimate because the estimate is derived from only U.S. sources and does not include any Canadian sources.

Table 3. Total annual estimated average human-caused mortality and serious injury for the Gulf of Maine/Bay of Fundy harbor porpoise (*Phocoena phocoena phocoena*) in U.S. waters.

Years	Source	Annual Avg.	CV
2018–2022	U.S. commercial fisheries using observer data	142	0.11
2018–2022	Non-fishery human caused stranding mortalities	0.2	-
2018–2022	Research takes	0.2	-
TOTAL		142.4	0.11

A key uncertainty in the U.S. bycatch estimate is the potential that the observer coverage in the Mid-Atlantic gillnet fishery may not be representative of the fishery during all times and places, since the observer coverage was relatively low (0.012–0.130) for some times and areas, especially during the COVID-19 pandemic (2020–2022). The effect of this is unknown. Another key uncertainty is that mortalities and serious injuries in Canadian waters are unquantified. There are no major known sources of unquantifiable human-caused mortality or serious injury for the U.S. waters within the Gulf of Maine/Bay of Fundy harbor porpoise stock's habitat.

United States

Northeast Gillnet[1]

Harbor porpoise bycatch in the northern Gulf of Maine occurs primarily from June to September, while in the southern Gulf of Maine and south of New England, bycatch occurs from January to May and September to December. Annual bycatch is estimated using ratio estimator techniques that account for the use of pingers (Orphanides 2021; Precoda and Orphanides 2022; Precoda 2023; Precoda 2024). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Northeast Bottom Trawl

Since 1989, harbor porpoise mortalities have been observed in the northeast bottom trawl fishery, but many of these mortalities were not attributable to this fishery because decomposed animals are presumed to have been dead prior to being taken by the trawl. Those infrequently caught freshly dead harbor porpoises have been caught during January to April on Georges Bank or in the southern Gulf of Maine. Fishery-related bycatch rates were estimated using an annual stratified ratio estimator (Lyssikatos and Chavez-Rosales 2022, Precoda and Lyssikatos 2024). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Mid-Atlantic Gillnet

Harbor porpoise bycatch in Mid-Atlantic waters occurs primarily from December to May in waters off New Jersey and less frequently in other waters ranging farther south, from New Jersey to North Carolina. Annual bycatch is estimated using ratio estimator techniques (Orphanides 2021; Precoda and Orphanides 2022; Precoda 2023; Precoda 2024). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Research Takes

One harbor porpoise was incidentally killed during research conducted during the NEFSC 2021 Bottom Trawl survey.

[1] Information reported here includes data from different types of gillnet gear found in the Northeast, including drift sink, drift float, anchor sink, and anchor float.

Table 4. From observer program data, summary of the incidental mortality of Gulf of Maine/Bay of Fundy harbor porpoise (*Phocoena phocoena phocoena*) by U.S. commercial fishery including the years sampled, the type of data used, the annual observer coverage, the mortalities and serious injuries recorded by on-board observers, the estimated annual serious injury and mortality, the estimated CV of the annual mortality, and the mean annual combined mortality with its CV.

Fishery	Years	Data Type [a]	Observer Coverage [b]	Obs. Serious Injury[c]	Obs. Mortality	Est. Serious Injury[c]	Est. Mortality	Est. Combined Mortality	Est. CVs	Mean Combined Annual Mortality
Northeast Gillnet	2018 2019 2020 2021 2022	Obs. Data, Trip Logbook, Allocated Dealer Data	0.11 0.12 0.02 0.11 0.15	0 0 0 0 0	9 33 10 25 22	0 0 2 2 0	92 195 119 109 118	92 195 121 111 118	0.52 0.22 0.22 0.19 0.22	127(0.12)
Mid-Atlantic Gillnet	2018 2019 2020 2021 2022	Obs. Data, Weighout	0.09 0.13 0.03 0.01 0.02	0 0 0 0 0	0 2 1 0 0	0 0 0 0 0	0 13 16 10 12	0 13 16 10 12	0 0.51 0.63 0.65 0.66	10 (0.39)
Northeast Bottom Trawl	2018 2019 2020 2021 2022	Obs. Data, Weighout	0.12 0.16 0.08 0.19 0.28	0 0 0 0 1	0 2 0 1 0	0 0 0 0 3	0 11 3.6 5.0 0	0 11 3.6 5.0 3	0 0.63 0.63 0.92 0.56	4.8 (0.49)
TOTAL										142 (0.11)

a. Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program. NEFSC collects Weighout (Weighout) landings data that are used as a measure of total effort for the U.S. gillnet fisheries. Mandatory vessel trip report (VTR; Trip Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast gillnet fishery.
b. Observer coverage for the U.S. Northeast and mid-Atlantic coastal gillnet fisheries is based on tons of fish landed. Northeast bottom trawl fishery coverages are ratios based on trips.
c. Serious injuries were evaluated for the 2018–2022 period and include both at-sea monitor and traditional observer data (Josephson and Lyssikatos 2023).

Canada

There is no current estimate of Canadian commercial fishery related bycatch of the Gulf of Maine/Bay of Fundy stock, but harbor porpoise interactions were documented in the Bay of Fundy sink gillnet fishery and in herring weirs between the years 1998–2001 in the lower Bay of Fundy demersal gillnet fishery (Trippel and Shepherd 2004) when Canada had an observer program, which is not currently operating. That fishery has declined since 2001 and it is assumed current bycatch is very small, if any (H. Stone, Department of Fisheries and Oceans Canada, pers. comm.).

STATUS OF STOCK

Harbor porpoise in the Gulf of Maine/Bay of Fundy stock are not listed as threatened or endangered under the Endangered Species Act.

The estimates of Nmin and human-caused mortalities and serious injuries (M/SI) are incomplete, thus additional analysis is required beyond a straightforward comparison of PBR to human-caused M/SI to determine strategic status. Nmin (56,420) is slightly negatively biased because the abundance survey covered about 90% of the known entire stock range that is in U.S. and Canadian waters. The estimate of human-caused mortalities and serious injuries (M/SI; 142) is negatively biased because the estimate was derived from activities only for U.S. waters and does not include takes from Canada. NMFS' Guidelines for Assessing Marine Mammal Stocks specify that when estimates of N_{MIN} and human-caused M/SI are incomplete, NMFS should calculate a "critical N_{MIN}," or the value of N_{MIN} that would result in the minimum estimate of human-caused M/SI to exceed PBR (NMFS 2023). The "critical N_{MIN}" is calculated as critical $N_{MIN} = (2 \times M/SI) / (R_{MAX} \times F_R)$. For the Gulf of Maine/Bay of Fundy harbor porpoise stock, the critical N_{MIN} is 12,344 ((2 × 142) / (0.046 × 0.5)). Although N_{MIN} and M/SI are considered underestimates, the N_{MIN} estimate that was calculated from the most recent available survey (56,420) is about 4.6 times higher than the critical N_{MIN}, so

it is likely that the stock's current N_{MIN} is greater than the critical N_{MIN} and thus the stock is considered not strategic under the MMPA. The total fishery-related mortality and serious injury for this stock in U.S. and Canadian waters is unknown and thus it is not known if it is insignificant and approaching a zero mortality and serious injury rate. The status of harbor porpoises, relative to OSP is unknown.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Strandings

United States

Recent harbor porpoise strandings on the U.S. Atlantic coast are documented in Table 5 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 November 2023). Of the 265 U.S. stranding mortalities reported during this time period, 16 were coded as having signs of human interaction. Of these, 1 was deemed a fishery interaction (assumed to be subsumed in the extrapolated fishery bycatch estimates). Most of the remaining Human Interaction (HI) cases were harassment, unlikely to have contributed to the stranding or post-mortem interactions. However, in 1 case the non-fishery human interaction was likely to have been a contributing factor in the animal's mortality.

Stranding data underestimate the extent of mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore 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 interaction.

Table 5. Harbor porpoise (*Phocoena phocoena phocoena*) reported strandings along the U.S. and Canadian Atlantic coast, 2018–2022.

Area	2018	2019	2020	2021	2022	Total
Maine[e, f]	8	7	8	9	16	48
New Hampshire	2	6	0	3	0	11
Massachusetts	13	68	13	14	16	124
Rhode Island	0	2	0	0	0	2
Connecticut	0	1	0	0	0	1
New York[e]	2	13	6	0	0	21
New Jersey	5	6	5	1	0	17
Delaware	0	3	0	1	0	4
Maryland	0	6	1	0	0	7
Virginia	1	6	0	0	1	8
North Carolina	3	13	0	0	2	18
TOTAL U.S.	38	131	33	28	35	265
Nova Scotia/Prince Edward Island[b]	16	22	32	37		141
Newfoundland and New Brunswick[c]	0	0	0	0		1
GRAND TOTAL	41	101	65	65		447

a. Two human interaction cases in 2018; both in Massachusetts. One was coded as a fishery interaction.
b. Data supplied by Nova Scotia Marine Animal Response Society (pers. comm.).
c. See Ledwell and Huntington (2018, 2019, 2020, 2021a, 2021b).
d. Three Massachusetts stranding mortalities in 2019 were classified as non-fishery human interaction.
e. Four human interaction cases in 2020, all of them due to activities by the public post-stranding. In 3 of these cases, the animal was released alive.
f. Five cases of human interactions in 2022. One was an existing satellite tag (restrand), 3 were refloat attempts by the public and 1 animal was found with fins cut off. One of the Maine harassments was coded as probably contributing to the mortality.

Canada

Whales and dolphins stranded on the coast of Nova Scotia, New Brunswick and Prince Edward Island are recorded by the Marine Animal Response Society and the Nova Scotia Stranding Network. See Table 5 for details.

Harbor porpoise stranded on the coasts of Newfoundland and Labrador are reported by the Newfoundland and Labrador Whale Release and Strandings Program (Ledwell and Huntington 2019, 2020, 2021a, 2021b; Table 5).

Habitat Issues

In U.S. waters, harbor porpoise are mostly found in nearshore areas and inland waters, including bays, tidal areas, and river mouths. As a result, in addition to fishery bycatch, harbor porpoise are vulnerable to contaminants, such as PCBs (Pierce et al. 2008; Hall et al. 2006), ship traffic (Oakley et al. 2017; Terhune 2015) and physical modifications resulting from urban and industrial development activities such as construction of docks and other over-water structures, dredging (Todd et al. 2015), installation of offshore windfarms (Carstensen et al. 2006; Brandt et al. 2011; Teilmann and Carstensen 2012; Dähne et al. 2013; Benjamins et al. 2017), seismic surveys and other sources of anthropogenic noise (Lucke et al. 2009).

Changes in spatial distribution and abundance, including poleward and depth shifts, have been documented in and predicted for a range of plankton species and commercially important fish stocks (Nye et al. 2009; Head et al. 2010; Pinsky et al. 2013; Poloczanska et al. 2013; Hare et al. 2016; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019; Thorne et al. 2022). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat factors. Results varied by season and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys during 2010 to 2017. During this time frame, the weighted centroid of harbor porpoise core habitat moved farthest during winter (397 km towards the northeast) and less than 20 km in the other seasons. Thorne et al. (2022) examined spatial patterns of odontocete strandings on the east coast of the US from 2000-2020 and found a poleward shift in the center of distribution of harbor porpoise strandings of 14.2 km/ year. There is uncertainty in how, if at all, the changes in distribution and population size of cetacean species may interact with changes in distribution of prey species and how the ecological shifts will affect human impacts to the species.

REFERENCES CITED

Barlow, J. and P. Boveng. 1991. Modeling age-specific mortality for marine mammal populations. Mar. Mamm. Sci. 7: 50–65.

Benjamins, S., N. van Geel, G. Hastie, J. Elliott and B. Wilson. 2017. Harbour porpoise distribution can vary at small spatiotemporal scales in energetic habitats. Deep-Sea Res. II. http://dx.doi.org/10.1016/j.dsr2.2016.07.002i

Brandt M.J., A. Diederichs, K. Betke and G. Nehls. 2011. Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. Mar Ecol Prog Ser 421:205–216. https://doi.org/10.3354/meps08888

Carstensen J., O.D. Henriksen and J. Teilmann. 2006. Impacts of offshore wind farm construction on harbour porpoises: Acoustic monitoring of echolocation activity using porpoise detectors (T-PODs). Mar Ecol Prog Ser. 321:295–308.

Caswell, H., S. Brault, A.J. Read and T.D. Smith. 1998. Harbor porpoise and fisheries: An uncertainty analysis of incidental mortality. Ecol. Appl. 8(4): 1226–1238.

Chavez-Rosales S., E. Josephson, D. Palka and L. Garrison. 2022. Detection of habitat shifts of cetacean species: a comparison between 2010 and 2017 habitat suitability conditions in the northwest Atlantic Ocean. Front. Mar. Sci. 9:877580. doi: 10.3389/fmars.2022.877580

Dähne, M., A. Gilles, K. Lucke, V. Peschko, S. Adler, K. Krugel, J. Sundermeyer and U. Siebert. 2013. Effects of pile-driving on harbour porpoises (*Phocoena phocoena*) at the first offshore wind farm in Germany. Environ. Res. Lett. 8: 1–15.

Garrison, L.P. and L.A. Dias. 2023. Abundance of marine mammals in waters of the southeastern U.S. Atlantic during summer 2021. SEFSC MMTD Contribution: #MMTD-2023-01. 23 pp. https://doi.org/10.25923/ce0d-9e10.

Gaskin, D.E. 1977. Harbour porpoise, *Phocoena phocoena* (L.), in the western approaches to the Bay of Fundy 1969–75. Rep. Int. Whal. Comm. 27:487–492.

Gaskin, D.E. 1984. The harbor porpoise *Phocoena phocoena* (L.): Regional populations, status, and information on direct and indirect catches. Rep. Int. Whal. Comm. 34: 569–586.

Gaskin, D.E. 1992. The status of the harbour porpoise. Can. Field-Nat. 106:36–54.

Grieve, B.D., J.A. Hare and V.S. Saba. 2017. Projecting the effects of climate change on *Calanus finmarchicus* distribution within the US Northeast continental shelf. Sci. Rep. 7:6264.

Hall, A.J., K. Hugunin, R. Deaville, R.J. Law, C.R. Allchin and P.D. Jepson. 2006. The risk of infection from polychlorinated biphenyl exposure in the harbor porpoise (*Phocoena phocoena*): A case-control approach. Environmental Health Perspectives 114(5):704–711.

Hare, J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, A.S. Chute, K.L. Curti, T.H. Curtis, D. Kurcheis, J.F. Kocik, S.M. Lucey, C.T. McCandless, L.M. Milke, D.E. Richardson, E. Robillard, H.J. Walsh, M.C. McManus, K.E. Maranick and C.A. Griswold. 2016. A vulnerability assessment of fish and invertebrates to climate change on the Northeast U.S. continental shelf. PLoS ONE. 11 (2016) e0146756. https://doi.org/10.1371/journal.pone.0146756.s014

Head, E.J.H. and P. Pepin. 2010. Spatial and inter-decadal variability in plankton abundance and composition in the Northwest Atlantic (1958–2006). J. Plankton Res. 32:1633–1648.

Holdman, A.K., N. Tregenza, S.M. Van Parijs, and A.I. DeAngelis. 2023. Acoustic ecology of harbour porpoise (*Phocoena phocoena*) between two US offshore wind energy areas. ICES Journal of Marine Science 2023(0):1-11. DOI: 10.1093/icesjms/fsad150.

Hiltunen, K.H. 2006. Mixed-stock analysis of harbor porpoises (*Phocoena phocoena*) along the U.S. mid-Atlantic coast using microsatellite DNA markers. M.Sc. Thesis. The College of Charleston, Charleston, SC. 92pp.

Johnston, D.W. 1995. Spatial and temporal differences in heavy metal concentrations in the tissues of harbour porpoises (*Phocoena phocoena* L.) from the western North Atlantic. M.Sc. Thesis. University of Guelph, Guelph, Ontario, Canada. 152pp.

Josephson, E.and M.C. Lyssikatos. 2023. Serious injury determinations for small cetaceans and pinnipeds caught in commercial fisheries off the northeast U.S. coast, 2017–2021. Northeast Fish. Sci. Cent. Ref. Doc. 23-11 36pp.

Kraus, S.D., J.H. Prescott and G.S. Stone. 1983. Harbor porpoise, *Phocoena phocoena*, in the U.S. coastal waters off the Gulf of Maine: A survey to determine seasonal distribution and abundance. NMFS. NA82FAC00027 22pp.

Kraus, S.D., A.J. Read, A. Solow, K. Baldwin, T. Spradlin, E. Anderson and J. Williamson. 1997. Acoustic alarms reduce porpoise mortality. Nature 388(6642): 525.

Laake, J.L. and D.L. Borchers. 2004. Methods for incomplete detection at distance zero. Pages 108-189 *in*: Advanced distance sampling. S. T. Buckland, D. R. Andersen, K. P. Burnham, J. L. Laake and L. Thomas (eds). Oxford University Press, New York.

Lawson J. and J-F. Gosselin. 2018. Estimates of cetacean abundance from the 2016 NAISS aerial surveys of eastern Canadian waters, with a comparison to estimates from the 2007 TNASS. NAMMCO SC/25/AE/09.

Ledwell, W. and J. Huntington. 2019. Incidental entrapments and entanglements of cetaceans and leatherback sea turtles, strandings, ice entrapments reported to the Whale Release and Strandings Group in Newfoundland and Labrador and a summary of the Whale Release and Strandings program during 2018. Report to the Department of Fisheries and Oceans Canada, St. John's, Newfoundland, Canada. 24pp.

Ledwell, W., J. Huntington, E. Sacrey and C. Landry. 2020. Entanglements in Fishing Gear and Strandings reported to the Whale Release and Strandings Group in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2019. Report to the Department of Fisheries and Oceans Canada, St. John's, Newfoundland, Canada. 24pp.

Ledwell, W., J. Huntington, N. Ledwell and C. Landry. 2021a. Entanglements in fishing gear reported to the Whale Release and Strandings Group in Newfoundland and Labrador and a summary of the Whale Release and Strandings program during 2020. Report to the Department of Fisheries and Oceans Canada, St. John's, Newfoundland, Canada. 21pp. Available at https://zenodo.org/record/5911328#.Y4jVuX3MI2w.

Ledwell, W., J. Huntington, C. Landry, N. Ledwell and J. Hanlon. 2021b. Entanglements in fishing gear reported to the Whale Release and Strandings Group in Newfoundland and Labrador and a summary of the Whale Release and Strandings program during 2021. Report to the Department of Fisheries and Oceans Canada, St. John's, Newfoundland, Canada. 21pp. Available at https://zenodo.org/record/5914689#.Y4ja1H3MKUk

Lucke, K., U. Siebert, P.A. Lepper and M-A. Blanchet. 2009. Temporary shift in masking hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. J. Acoust. Soc. Am. 125(6):4060–4070.

Lyssikatos, M. S. Chavez-Rosales. 2022. Estimation of cetacean and pinniped bycatch in northeast and mid-Atlantic bottom trawl fisheries, 2015–2019. NOAA Tech. Memo. NMFS-NE-281.

MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: A review and synthesis. Endang. Species Res. 7:125–136.

Moore, J.E. and A.J. Read. 2008. A Bayesian uncertainty analysis of cetacean demography and bycatch mortality using age-at-death data. Ecol. Appl. 18(8):1914–1931.

Morley, J.W., R.L. Selden, R.J. Latour, T.L. Frolicher, R.J. Seagraves and M.L. Pinsky. 2018. Projecting shifts in thermal habitat for 686 species on the North American continental shelf. PLoS ONE 13(5):e0196127.

NMFS [National Marine Fisheries Service]. 1992. Harbor porpoise in Eastern North America: Status and Research Needs. Results of a scientific workshop held May 5–8, 1992 at NEFSC, Woods Hole, MA, USA. Northeast Fish. Sci. Cent. Ref. Doc., 92-06. National Marine Fisheries Service. 28pp.

Nye, J., J. Link, J. Hare and W. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Mar. Ecol. Prog. Ser. 393:111–129.

Oakley, J.A., A.T. Williams and T. Thomas. 2017. Reactions of harbor porpoise (*Phocoena phocoena*) to vessel traffic in the coastal waters of South West Wales, UK. Ocean & Coastal Management 138:158–169.

Orphanides, C.D. 2021. Estimates of cetacean and pinniped bycatch during 2018 in the New England sink and Mid-Atlantic illnet fisheries. Northeast Fish Sci Cent Ref Doc. 21-01. 16pp.

Palka, D. 1995. Influences on spatial patterns of Gulf of Maine harbor porpoises. Pages 69–75 *in*: A.S. Blix, L. Walloe and O. Ulltang (eds). Whales, Seals, Fish and Man. Elsevier Science. Amsterdam.

Palka, D.L., A.J. Read, A.J. Westgate and D.W. Johnston. 1996. Summary of current knowledge of harbour porpoises in US and Canadian Atlantic waters. Rep. Int. Whal. Comm. 46:559–565.

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. Northeast Fish. Sci. Cent. Ref. Doc. 00-07. 29pp. https://repository.library.noaa.gov/view/noaa/3290.

Palka, D.L. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. Northeast Fish. Sci. Cent. Ref. Doc. 12-29. 37pp. https://repository.library.noaa.gov/view/noaa/4312

Palka, D. 2020. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2016 line transect surveys conducted by the Northeast Fisheries Science Center. Northeast Fish. Sci. Cent. Ref. Doc. 20-05. DOI : https://doi.org/10.25923/1mrt-tn89.

Palka, DL. 2023. Cetacean abundance in the US Northwestern Atlantic Ocean, Summer 2021. Northeast Fish. Sci. Cent. Ref. Doc. 23-08. 67pp. https://repository.library.noaa.gov/view/noaa/50424

Pierce, G.J. M.B. Santos, S. Murphy, J.A. Learmonth, A.F. Zuur, E. Rogan, P. Bustamante, F. Caurant, V. Lahaye, V. Ridoux, B.N. Zegers, A. Mets, M. Addink, C. Smeenk, T. Jauniaux, R.J. Law, W. Dabin, A. López, J.M. Alonso Farré, A.F. González, A. Guerra, M. García-Hartmann, R.J. Reid, C.F. Moffat, C. Lockyer, J.P. Boon. 2008. Bioaccumulation of persistent organic pollutants in female common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*) from western European seas: Geographical trends, causal factors and effects on reproduction and mortality. Environmental Pollution. 153:401–415.

Pinsky, M.L., B. Worm, M.J. Fogarty, J.L. Sarmiento and S.A. Levin. 2013. Marine taxa track local climate velocities. Science 341:1239–1242.

Polacheck, T. 1989. Harbor porpoises and the gillnet fishery. Oceanus 32(1):63–70.

Poloczanska, E.S., C.J. Brown, W.J. Sydeman, W. Kiessling, D.S. Schoeman, P.J. Moore, K. Brander, J.F. Bruno, L.B. Buckley, M.T. Burrows, C.M. Duarte, B.S. Halpern, J. Holding, C.V. Kappel, M.I. O'Connor, J.M. Pandolfi, C. Parmesan, F. Schwing, S.A. Thompson and A.J. Richardson. 2013. Global imprint of climate change on marine life. Nat. Clim. Change 3:919–925.

Precoda, K. 2023. Estimates of cetacean and pinniped bycatch in the New England and Mid-Atlantic gillnet fisheries in 2020 and 2021. Northeast Fish. Sci. Cent. Ref. Doc. 23-10. 25pp. https://repository.library.noaa.gov/view/noaa/52076

Precoda, K. and C.D. Orphanides. 2022. Estimates of cetacean and pinniped bycatch in the 2019 New England sink and Mid-Atlantic gillnet fisheries. Northeast Fish. Sci. Cent. Ref. Doc. 22-05. 21pp. https://repository.library.noaa.gov/view/noaa/39407

Precoda, K. 2024. Estimates of cetacean and pinniped bycatch in the New England and Mid-Atlantic gillnet fisheries, 2022. Northeast Fish. Sci. Cent. Ref. Doc. 24-06. 80pp.

Precoda, K. and M.C. Lyssikatos. 2024. Estimates of cetacean and pinniped bycatch in the Northeast and Mid-Atlantic bottom trawl fisheries, 2022. Northeast Fish. Sci. Cent. Ref. Doc. 24-05. 15pp.

Read, A.J. and A.A. Hohn. 1995. Life in the fast lane: The life history of harbour porpoises from the Gulf of Maine. Mar. Mamm. Sci. 11(4):423–440.

Read, A.J. and A.J. Westgate. 1997. Monitoring the movements of harbour porpoises (*Phocoena phocoena*) with satellite telemetry. Ma. Biol. 130:315–22.

Rosel, P.E., S.C. France, J.Y. Wang and T.D. Kocher. 1999a. Genetic structure of harbour porpoise *Phocoena phocoena* populations in the northwest Atlantic based on mitochondrial and nuclear markers. Mol. Ecol. 8:S41-S54.

Rosel, P.E., R. Tiedemann and M. Walton. 1999b. Genetic evidence for limited trans-Atlantic movements of the harbor porpoise *Phocoena phocoena*. Mar. Biol. 133:583–591.

Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate change? Developing and testing a new index. Ecol. Indic. 98:9–18.

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(1):157–175.

Teilmann, J. and J. Carstensen. 2012. Negative long term impacts on harbor porpoises from a large scale offshore wind farm in the Baltic—evidence of a slow recovery. Environ. Res, Lett. 7:045101.

Terhune, J.M. 2015. Harbour porpoise presence near oil tankers. J. Canadian Ac. 43(3). 2pp.

Thomas L., J.L. Laake, E. Rexstad, S. Strindberg, F.F.C. Marques, S.T. Buckland, D.L. Borchers, D.R. Anderson, K.P. Burnham, M.L. Burt, S.L. Hedley, J.H. Pollard, J.R.B. Bishop and T.A. Marques. 2009. Distance 6.0. Release 2. University of St. Andrews (UK): Research Unit for Wildlife Population Assessment. http://distancesampling.org/Distance/

Thorne, L.H., E.I. Heywood and N.O. Hirtle. 2022. Rapid restructuring of the odontocete community in an ocean warming hotspot. Glob. Change Biol., 28(22): 6524-6540.

Todd, V.L.G., I.B. Todd, J.C. Gardiner, E.C.N. Morrin, N.A. MacPherson, N.A. DiMarzio and F. Thomsen. 2015. A review of impacts of marine dredging activities on marine mammals. ICES J. of Mar. Sci. 72(2):328–340.

Trippel, E.A. and T.D. Shepherd. 2004. By-catch of harbour porpoise (*Phocoena phocoena*) in the Lower Bay of Fundy gillnet fishery from 1998–2001. Department of Fisheries and Oceans. Ottawa, Ontario. DFO Research Document 2004/2521 iv + 33 pp. http://www.fmap.ca/ramweb/papers-total/Trippel_Shepherd_2004.pdf

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

Wang, J.Y., D.E. Gaskin and B.N. White. 1996. Mitochondrial DNA analysis of harbour porpoise, *Phocoena phocoena*, subpopulations in North American waters. Can. J. Fish. Aquat. Sci 53:1632–45.

Westgate, A.J., D.C.G. Muir, D.E. Gaskin and M.C.S. Kingsley. 1997. Concentrations and accumulation patterns of organochlorine contaminants in the blubber of harbour porpoises, *Phocoena phocoena*, from the coast of Newfoundland, the Gulf of St. Lawrence and the Bay of Fundy/Gulf of Maine. Envir. Pollut. 95:105–119.

Westgate, A.J., A.J. Read, T.M. Cox, T.D. Schofield, B.R. Whitaker and K.E. Anderson. 1998. Monitoring a rehabilitated harbor porpoise using satellite telemetry. Mar. Mamm. Sci. 14(3):599–604.

Westgate, A.J. and K.A. Tolley. 1999. Geographical differences in organochlorine contaminants in harbour porpoises *Phocoena phocoena* from the western North Atlantic. Mar. Ecol. Prog. Ser. 177:255–268.

Wingfield, J.E., M. O'Brien, V. Lyubchich, J.J. Roberts, P.N. Halpin, A.N. Rice and H. Bailey. 2017. Year-round spatiotemporal distribution of harbor porpoises within and around the Maryland wind energy area. PLoS ONE. 12(5):e0176653. https:// doi.org/10.1371/journal.pone.0176653

Woodley, T.H. and A.J. Read 1991. Potential rates of increase of a harbor porpoise (*Phocoena phocoena*) population subjected to incidental mortality in commercial fisheries. Can. J. Fish. Aquat. Sci 48:2429–35.

GRAY SEAL (*Halichoerus grypus atlantica*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal (*Halichoerus grypus*) is found on both sides of the North Atlantic, with three major populations: Northeast Atlantic, Northwest Atlantic, and the Baltic Sea (Haug et al. 2007). The Northeast Atlantic and the Northwest Atlantic populations are classified as the subspecies *H. g. atlantica* (Olsen et al. 2016). The Northwest Atlantic population defines the western North Atlantic stock which represents a transboundary stock ranging from New Jersey to Labrador (Davies 1957; Mansfield 1966; Katona et al. 1993; Lesage and Hammill 2001). This stock is separated from the northeastern Atlantic stocks by geography, differences in the breeding season, and mitochondrial and nuclear DNA variation (Bonner 1981; Boskovic et al. 1996; Lesage and Hammill 2001; Klimova et al. 2014). In the Canadian portion of its range, the Northwest population contains two breeding aggregations: Scotian Shelf (Sable Island and coastal Nova Scotia) and Gulf of St. Lawrence (DFO 2022). Outside of the breeding season, animals from these two breeding aggregations mix with a third breeding aggregation of animals breeding in U.S. waters (Lavigueur and Hammill 1993; Harvey et al. 2008; Breed et al. 2006, 2009), and all three breeding aggregations are considered a single population based on genetic similarity (Boskovic et al. 1996; Wood et al. 2011). The population has been described as a metapopulation with a mainland-island structure, due to the size of the breeding colony on Sable Island in relation to other colonies and the movement of animals between them (den Heyer et al. 2020).

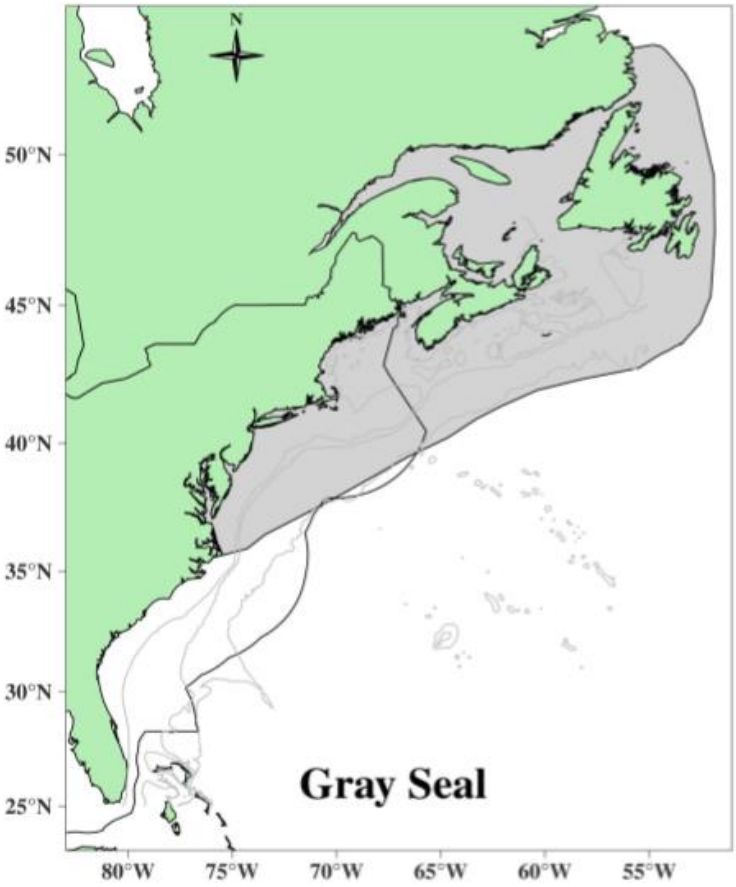


Figure 1. Approximate range of the Western North Atlantic stock of gray seals (*Halichoerus grypus atlantica*).

After near extirpation due to bounties, which ended in the 1960s, small numbers of animals and pups were observed on several isolated islands along the Maine coast and in Nantucket Sound, Massachusetts (Katona et al. 1993; Rough 1995; Gilbert et al. 2005). In December 2001, NMFS initiated aerial surveys to monitor gray seal pup production on Muskeget Island and adjacent sites in Nantucket Sound, and Green and Seal Islands off the coast of

Maine (Wood et al. 2007). Tissue samples collected from Canadian and U.S. populations were examined for genetic variation using mitochondrial and nuclear DNA (Wood et al. 2011). All individuals were identified as belonging to one population, confirming the new U.S. population was recolonized by Canadian gray seals. The genetic evidence (Boskovic et al. 1996; Wood et al. 2011, Cammen et al. 2018) provides a high degree of certainty that the western North Atlantic stock of gray seals comprise a single metapopulation. Further supporting evidence comes from sightings of seals in the U.S. that had been branded on Sable Island, resights of tagged animals, and satellite tracks of tagged animals (Nowak et al. 2020; Murray et al. 2021). The amount of mixing and percentage of time that individuals use U.S. and Canadian waters is unknown.

POPULATION SIZE

Currently there is a lack of information on the rate of exchange between animals in the U.S. and Canada, which may influence seasonal changes in abundance throughout the range of this transboundary species as well as life history parameters in population models. As a result, the size of the Northwest Atlantic gray seal population is estimated separately for the portion of the population in Canada versus the U.S., and mainly reflects the size of the breeding population in each respective country (Table 1). Total pup production in 2021 at breeding colonies in Canada was estimated to be 98,200 pups (95% CI = 86,800 - 109,700; DFO 2022). Production at Gulf of St. Lawrence, and Scotian Shelf colonies accounted for 17%, and 83%, respectively, of the estimated total number of pups born. Population models, incorporating estimates of age-specific reproductive rates and removals, are fit to these pup production estimates to estimate total population levels in Canada. The total Canadian gray seal population in 2021 was estimated to be 366,400 (95% CI=317,800 to 409,400; DFO 2022). Uncertainties in the population estimate are derived from uncertainties in life history parameters such as mortality rates and sex ratios (DFO 2022).

In U.S. waters, the number of pupping sites has increased from 1 in 1988 to 9 in 2021 and are located in Maine and Massachusetts (Wood et al. 2022). Although white-coated pups have stranded on eastern Long Island beaches in New York, no pupping colonies have been detected in that region. An estimated 6,663 pups were born in 2021 at U.S. breeding colonies (Wood et al. 2022), approximately 6% of the total pup production over the entire range of the population (DFO 2022). Muskeget Island is the largest pupping colony in the U.S. and the third largest of all colonies across the U.S. and Canada (den Heyer et al. 2020). Mean rates of increase in the minimum number of pups born at various times since 1988 at 4 of the more frequently surveyed pupping sites (Muskeget, Monomoy, Seal, and Nomans Islands) ranged from 11.5% (95%CI: 3.7–19.2%) to 44.1% (95% CI: 28.1–60.2%; Wood et al. 2022), though annualized growth rates have been decreasing at most of these sites in recent years (Wood et al. 2022). High rates of increase provide further support that seals recruited to some U.S. colonies at various times from larger established breeding colonies in Canada, although recent evidence suggests a slowing of growth rates relative to early recolonization (Wood et al. 2022).

The number of pups born at U.S. breeding colonies can be used to approximate the total size (pups and adults) of the gray seal population in U.S. waters, based on the ratio of total population size to pups in Canadian waters (4.19:1, based on the ratio of total population to pups in the Canadian portion of the stock in 2016) (Wood et al. 2022). Although not yet measured for U.S. waters, this ratio falls within the range of other adult to pup ratios suggested for pinniped populations (Harwood and Prime 1978; Thomas et al. 2019). A simple multiplier is used to estimate population size because vital rates (age-specific reproductive rates, survival) necessary for fitting age-structured population models to pup counts are not available for the portion of the population in U.S. waters. The multiplier used assumes the vital rates in Canadian waters are the same as in the U.S.. Using this approach, the population estimate during the pupping season in U.S. waters is 27,911. There is no coefficient of variation (CV) around the expansion factor, and likewise, the population estimate resulting from the application of the correction factor to the number of pups born. There is further uncertainty in this abundance level in the U.S. because life history parameters that influence the ratio of pups to total individuals in this portion of the population are unknown. It also does not reflect seasonal changes in stock abundance in the Northeast region for a transboundary stock. For example, roughly 24,000 seals were observed in southeastern Massachusetts alone in 2015 (Pace et al. 2019), yet 28,000–40,000 gray seals were estimated to be in this region in 2015 using correction factors applied to seal counts obtained from Google Earth imagery (Moxley et al. 2017).

Table 1. Summary of recent abundance estimates for the western North Atlantic gray seal (*Halichoerus grypus atlantica*) by year, and area covered, resulting total abundance estimate and 95% confidence interval.

Year	Area	N_{est} [a]	CI
2016[b]	Gulf of St Lawrence + Nova Scotia Eastern Shore + Sable Island	424,300	263,600–578,300
2016	U.S.	27,300[c]	NA
2021[d]	Gulf of St Lawrence + Scotian Shelf	366,400	317,800 - 409,400
2021[e]	U.S.	27,911[d]	NA

a. These are model-based estimates derived from pup surveys.
b. DFO 2017
c. This is derived from total population size to pup ratios in Canada, applied to U.S. pup counts.
d. DFO 2022
e. Wood et al. 2022

Minimum Population Estimate

The minimum population estimate 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 distribution as specified by Wade and Angliss (1997). When the variance around the expansion factor is unknown, a default CV of 0.20 is recommended for calculating a minimum population estimate rather than assuming zero variance in the correction factor (Wade and Angliss 1997), and was used to calculate Nmin for the U.S. Based on an estimated U.S. population in 2021 of 27,911, the minimum population estimate in U.S. waters is 23,624 and 359,332 in Canada, for a total Nmin of 376,621 (Table 2). Similar to the best abundance estimate, there is uncertainty in this minimum abundance level in the U.S. because life history parameters that influence the ratio of pups to total individuals in this population are unknown. Furthermore, the U.S. minimum population estimate reflects a portion of the stock's range and may vary seasonally as some portion of the larger stock moves in and out of U.S. waters.

Current Population Trend

In the U.S., the estimated mean rate of increase in the minimum number of pups born was 20.9% on Muskeget Island from 1988–2021, 19.9% on Monomoy Island from 2009–2021, 44.1% on Nomans Island from 2011–2021, and 11.5% on Seal Island from 2000–2021 (Wood et al. 2022). Since 2011, the growth rate at these colonies has been slower and less variable (Wood et al. 2022). These increases only reflect increases in pupping and as such are not an accurate or precise measure of total population growth. The latter is also influenced by juvenile and adult survival, as well as immigration from Canadian waters.

The total population of gray seals in Canada was estimated to be increasing by 4.4% per year from 1960–2016 (Hammill et al. 2017), primarily due to increases at Sable Island. Pup production on Sable Island increased exponentially at a rate of 12.8% per year between the 1970s and 1997 (Bowen et al. 2003). The 2021 survey marked the first time in 60 years that the estimate of pup production had decreased on Sable Island, though total pup production in the Gulf and Scotian Shelf was not significantly different than in 2016 (den Heyer et al. 2022). Pupping also occurs on Hay Island off Nova Scotia, in colonies off southwestern Nova Scotia, and in the Gulf of St. Lawrence. Since 1997, the rate of increase has slowed (Bowen et al. 2011; den Heyer et al. 2017), supporting the hypothesis that density-dependent changes in vital rates may be limiting population growth. Based on the most recent assessment of animals in Canada, the population increased at a rate of 1.5% per year between 2016 and 2021 (DFO 2022).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.128, based on historic rates of increase observed on Sable Island (Bowen et al. 2003).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of 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). An adjusted PBR is reported for managing gray seals in U.S. waters (NMFS 2023) because information on fisheries mortality in Canada is unknown (DFO 2022), and some portion of the Canadian animals likely never enters U.S. waters (O'Boyle and

Sinclair 2012). The adjusted PBR is based on the portion of the minimum total stock size estimated to be in U.S. waters (Table 2). The minimum population size for the portion of the stock residing in U.S. waters is 23,624. The maximum productivity rate is 0.128. The recovery factor (Fr) for this stock is 0.5, given incomplete information on human-caused mortality and serious injury of this stock in both U.S. and Canadian waters. Likewise, there is uncertainty in seasonal changes in gray seal abundance in U.S. waters, and rates of exchange between animals in Canada and the U.S. Using this Fr, the PBR for the western North Atlantic stock of gray seals is 12,052. The PBR adjusted for the portion of this stock in U.S. waters is 756 animals (Table 2).

Table 2. Best (N_{est}) and minimum abundance (N_{min}) estimates for the western North Atlantic gray seal (*Halichoerus grypus atlantica*) with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) used to calculate a range-wide and U.S. adjusted PBR.

Area	N_{est}	CV	N_{min}	F_r	R_{max}	PBR
U.S.	27,911	0.20 (default)	23,624			756
Range-wide	394,311	0.05	376,621	0.5	0.128	12,052

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2018-2022, the average annual estimated human-caused mortality and serious injury to gray seals in the U.S. was 1,309 and for Canada was 3,182, not including the unknown mortality from commercial fisheries, resulting in a total minimum estimate of 4,491 per year. No new data from Canada has been published with respect to the sources listed in Table 3. Mortality in U.S. fisheries is explained in further detail below.

Table 3. The total annual estimated average human-caused mortality and serious injury for the western North Atlantic gray seal (*Halichoerus grypus atlantica*).

Years	Source	Annual Est. Avg.
2018–2022	U.S. commercial fisheries using observer data	1,275
2018-2022	U.S. commercial fisheries using stranding data (serious injuries)	15(minimum count)
2018-2022	U.S. non-fishery human-caused stranding mortalities and serious injuries	19
2018-2022	U.S. research mortalities	0.2.0
	U.S. Total	1,309
2017–2021	Canadian commercial harvest	1018
2017–2021	DFO Canada scientific collections	84
2017–2021	Canadian removals of nuisance animals	2,080
2017–2021	Canadian commercial fisheries bycatch	Unknown
U.S. and Canadian TOTAL		4,491

Some human-caused mortality or serious injury may not be able to be quantified. Observed serious injury rates are lower than would be expected from the anecdotally observed numbers of gray seals living with ongoing entanglements. Estimated rates of entanglement in gillnet gear, for example, may be biased low because 100% of observed animals are dead when they come aboard the vessel (Josephson 2023); therefore, rates do not reflect the number of live animals that may have broken free of the gear, but remain entangled. Counts of live animals living

with entanglements can be informed by strandings data or research studies. For example, at least 24 live seals were observed entangled in monofilament net on Cape Cod in a study where mean prevalence of live entangled gray seals ranged from roughly 1 to 4% at haul-out sites in Massachusetts and Isles of Shoals (Iruzun Martins et al. 2019) (Table 6). Incomplete information on the true number of seals living with serious injuries from entanglements increases the amount of uncertainty in the estimated fisheries-related mortality.

Fishery Information

Detailed fishery information is given in Appendix III.

United States

Northeast Gillnet[1]

Annual mortalities were estimated using annual stratified ratio-estimator methods *(*Orphanides 2021; Precoda and Orphanides 2022; Precoda 2023; Precoda 2024). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Northeast Bottom Trawl

Annual mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos and Chavez-Rosales 2022; Precoda and Lyssikatos 2024). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Mid-Atlantic Bottom Trawl

Annual mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos and Chavez-Rosales 2022; Precoda and Lyssikatos 2024). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Mid-Atlantic Gillnet

Annual mortalities were estimated using annual stratified ratio-estimator methods (Orphanides 2021; Precoda and Orphanides 2022; Precoda 2023; Precoda 2024). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Gulf of Maine Atlantic Herring Purse Seine Fishery

No mortalities have been observed in this fishery during the current 5-year period, however, 1 gray seal was captured and released alive in 2018 (Josephson 2023).

Northeast Mid-Water and Pair Trawl

Only 1 gray seal was observed in these fisheries from 2018-2022 and an expanded bycatch estimate has not been generated. See Table 4 for observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

[1] Information reported here includes data from different types of gillnet gear found in the Northeast, including drift sink, drift float, anchor sink, and anchor float.

Table 4. Summary of the incidental mortality and serious injury of gray seals (*Halichoerus grypus atlantica*) by U.S. commercial fishery including the years sampled, the type of data used (Data Type), the annual observer coverage (Observer Coverage), mortality recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type[a]	Observer Coverage[b]	Observed Serious Injury[c]	Observed Mortality	Est. Serious Injury	Est. Mortality	Est. Comb. Mortality	Est. CVs	Mean Annual Combined Est. Mortality
Northeast Gillnet	2018 2019 2020 2021 2022	Obs. Data, Weighout, Trip Logbook	0.11 0.12 0.02 0.11 0.15	0 0 0 0 1	103 251 14 48 88	0 0 0 0 6	1113 2014 1357 1027 516	1113 2014 1357 1027 522	0.32 0.17 0.14 0.14 0.12	1,208 (0.09)
Mid-Atlantic Gillnet	2018 2019 2020 2021 2022	Obs. Data, Trip Logbook, Allocated Dealer Data	0.09 0.13 0.03 0.01 0.02	0 0 0 0 0	0 3 0 0 0	0 0 0 0 0	0 18 9 7 8	0 18 9 7 8	0 0.40 0.72 0.69 0.81	8 (0.38)
Northeast Bottom Trawl [e]	2018 2019 2020 2021 2022	Obs. Data, Trip Logbook	0.12 0.16 0.08 0.19 0.28	0 0 0 0 0	5 6 7 2 7	0 0 0 0 0	32 30 26 7.5 25	32 30 26 7.5 25	0.42 0.37 0.26 0.60 0.22	24 (0.15)
Mid-Atlantic Bottom Trawl	2018 2019 2020 2021 2022	Obs. Data, Trip Logbook	0.12 0.12 0.02 0.04 0.08	1 0 0 0 0	7 3 13 0 6	9 0 0 0 0	26 56 22 35 0 64	56 22 35 0 64	0.58 0.53 0.35 0 0.37	35(0.32)
Northeast Mid-water Trawl – Incl.Pair Trawl	2018 2019 2020 2021 2022	Obs. Data, Trip Logbook	0.14 0.28 0.13 0.36 0.65	0 0 0 0 0	1 0 0 0 0	0 0 0 0 0	na 0 0 0 0	na 0 0 0 0	na 0 0 0 0	0.2 (na)[d]
TOTAL										1275 (0.08)

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast multispecies gillnet fishery.

b. The observer coverages for the Northeast gillnet fishery and the Mid-Atlantic gillnet fisheries are ratios based on tons of fish landed. Northeast bottom trawl, Mid-Atlantic bottom trawl, and mid-water trawl fishery coverages are ratios based on trips. Total observer coverage reported for bottom trawl gear and gillnet gear includes traditional fisheries observers in addition to fishery monitors through the Northeast Fisheries Observer Program (NEFOP).

c. Serious injuries were evaluated for the 2018–2022 period (Josephson et al. in press).

d. No estimate made. Raw counts provided.

e. Due to the impact of the COVID-19 pandemic on observer coverage, the 3-year average mortality estimate from 2017. to–2019 was used to estimate mortality and serious injury for the calendar year 2020. The observed numbers are included in the usual columns for the sake of documentation only.

Research Takes

From 2018–2022 there was 1 gray seal mortality which occurred incidental to research activities under MMPA/ESA permits in 2020. No gray seal mortalities or serious injuries were reported during this period through the Protected Species Incidental Take database, which covers incidentally captured protected species in NMFS fisheries research surveys including those funded and directed by NMFS and includes partner surveys.

Canada

There is limited information on Canadian fishery bycatch (DFO 2017). Historically, an unknown number of gray seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets; Atlantic Canada and Greenland salmon gillnets; Atlantic Canada cod traps, and Bay of Fundy herring weirs (Read 1994). The lack of information on bycatch in Canada increases the uncertainty in the total level of fishery mortality impacting this transboundary stock.

STATUS OF STOCK

The range-wide average annual human-caused mortality and serious injury of gray seals during 2018–2022 does not exceed PBR. While the range-wide average annual human-caused mortality and serious injury is considered incomplete and thus an underestimate, and the average annual human-caused mortality and serious injury in U.S. waters exceed the PBR of the U.S. portion of the stock, if complete range-wide information were available, human-caused mortality and serious injury is unlikely to be of such magnitude greater such that it would exceed the range-wide PBR for this stock. Thus, this stock is not considered strategic (NMFS 2023). The status of this stock relative to Optimum Sustainable Population is unknown, but the stock's abundance appears to be increasing in Canadian and U.S. waters. Total U.S. commercial fishery-related mortality and serious injury for this stock is not less than 10% of the PBR adjusted for U.S. waters and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Strandings

United States

Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960s (Katona et al. 1993; Lelli et al. 2009). This hunt may have severely depleted this stock in U.S. waters (Rough 1995; Lelli et al. 2009). Other sources of mortalities caused by human interactions include boat strikes, power plant entrainment, oil spill/exposure, harassment, plastic ingestion, and shooting. Table 5 presents summaries of gray seal strandings as reported to the NOAA National Marine Mammal Health and Stranding Response Database (accessed 21 November 2023). Most stranding mortalities were in Massachusetts, which is the center of gray seal abundance in U.S. waters. Stranding data are effort-dependent and opportunistic, and represent only a fraction of both natural and anthropogenic mortality. In an analysis of mortality causes of stranded marine mammals on Cape Cod and southeastern Massachusetts between 2000 and 2006, Bogomolni et al. (2010) reported that 45% of gray seal stranding mortalities were attributed to human interaction. Stranding mortalities that are attributed to fishery interactions overlap with the modeled analysis of fishery bycatch based on NMFS observer coverage and so, while included in Table 5 below and summarized in Table 6, are not added to the total annual estimated human-caused mortality presented in Table 3.

In addition to stranding mortalities, there are live stranded animals with serious injuries from human interaction. Table 6 presents a summary of these live animals as reported to the NOAA National Marine Mammal Health and Stranding Response Database (accessed 21 November 2023) A serious injury is defined as an injury that has a >50% chance of resulting in a mortality (NMFS 2023), and includes animals with characteristics such as gear constrictions or with the potential to constrict, ingested gear or hooks, and visible fractures. Data on animals living with serious injuries are effort-dependent and opportunistic, and may or may not be attributable to a source. Counts of serious injuries currently represent a minimum and may also include repeat sightings of the same individual; these counts could be improved, and potentially expanded from estimated entanglement rates, with systematic surveys, standardized reporting, and a system to uniquely identify individual seals.

An Unusual Mortality Event (UME) was declared in July 2018 due to increased numbers of harbor and gray seal strandings along the U.S. coasts of Maine, New Hampshire, and Massachusetts. From July 1, 2018 to March 13, 2020, over 3,000 seals (including harbor and gray seals) stranded from Maine to Virginia. The preliminary cause of the UME was attributed to a phocine distemper outbreak (https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/2018-2020-pinniped-unusual-mortality-event-along). In addition, a UME was declared in 2022 due to elevated numbers of dead gray and harbor seals in Maine during June and July, due to positive cases of H5N1 highly pathogenic avian influenza transmitted from wild birds. Twenty-eight of the 181 seals included in the month-long UME were gray seals.(https://www.fisheries.noaa.gov/marine-life-distress/2022-pinniped-unusual-mortality-event-along-maine-coast).

Table 5. Gray seal (*Halichoerus grypus atlantica*) stranding mortalities along the U.S. Atlantic coast (2018-2022) with subtotals of animals recorded as pups in parentheses.

State	2018	2019	2020	2021	2022	Total
Maine	25 (0)	15 (0)	24 (2)	12 (3)	29 (5)	105(10)
New Hampshire	9 (3)	5 (0)	5 (0)	3 (1)	8 (3)	30 (7)
Massachusetts	261 (29)	260 (80)	199 (25)	164 (16)	187 (29)	1071(179)
Rhode Island	20 (3)	28 (8)	19 (0)	3 (2)	13 (5)	83 (18)
Connecticut	1 (0)	0	1 (0)	0	0	2(0)
New York	25 (1)	43 (4)	30 (4)	3 (1)	24 (11)	125(21)
New Jersey	14 (10)	9 (8)	5 (4)	3 (3)	9 (8)	40 (33)
Delaware	4 (2)	2 (1)	1 (0)	2 (1)	2 (1)	11(5)
Maryland	1 (1)	0	0	0	1 (1)	2 (2)
Virginia	1 (1)	0	0	1 (0)	1 (0)	3(1)
North Carolina	5 (2)	0	1 (0)	0	0	6 (2)
Total	366 (52)	362 (101)	285 (35)	191 (27)	274	1478 (278)
Unspecified seals (all states)	92	80	45	31	81	329

Table 6. Documented gray seal (*Halichoerus grypus atlantica*) human-interaction related stranding mortalities and serious injuries along the U.S. Atlantic coast (2018–2022) by type of interaction.

	TypeCause	2018	2019	2020	2021	2022	Total
Mortalities	Fishery Interaction[a]	10	8	4	3	4	29
	Boat Strike	2	1	2	0	2	7
	Shot	0	0	1	0	0	1
	Human Interaction - Other	9	13	2	1	9	34
Serious Injuries	Fishery interaction	35	24	9	9	0	77
	Disentangled and released[b]	7	25	22	13	11	78
	Human interaction - other	11	5	8	5	3	32
TOTAL		74	76	48	31	29	258

[a]Fishery interaction mortalities are not added to the total annual estimated human-caused mortality presented in Table 3 because they are subsumed in the total estimated mortality calculated from observer data.
[b]Injuries on animals that have been disentangled and released are considered to not be serious. These animals are not included in Table 3.

Canada

Between 2017–2021, the average annual human-caused mortality and serious injury to gray seals in Canadian waters from commercial harvest is 1,018, though up to 60,000 seals/year are permitted (http://www.dfo-mpo.gc.ca/decisions/fm-2015-gp/atl-001-eng.htm). This included: 1,421 in 2017, 64 in 2018, 1,236 in 2019, 2,219 in 2020, and 240 in 2021 (DFO 2022). In addition, between 2017 and 2021, an average of 2,080 nuisance animals per year were killed. This included 3,368 in 2017, 3,462 in 2018, 3,571 in 2019 (DFO 2017), 0 in 2020, and 0 in 2021, based on the total number of licenses that were issued. Lastly, DFO took 90 animals in 2017, 61 animals in 2018, 66 animals in 2019, 127 animals in 2020, and 75 animals in 2021 for scientific collections, for an annual average of 84 animals (DFO 2022).

REFERENCES CITED

Anthony, S.J., J.A. St. Leger, K. Pugliares, H.S. Ip, J.M. Chan, Z.W. Carpenter, I. Navarrete-Macias, M. Sanchez-Leon, J.T. Saliki, J. Pedersen, W. Karesh, P. Daszak, R. Rabadan, R. Rowles and W.I. Lipkin. 2012. Emergence of fatal avian influenza in New England harbor seals. mBio 3(4):e00166-12. DOI: 10.1128/mBio.00166-12

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.

Bogomolni, A.L., K.R. Pugliares, S.M. Sharp, K. Patchett, C.T. Harry, J.M. LaRocque, K.M. Touhey and M. Moore. 2010. Mortality trends of stranded marine mammals on Cape Cod and southeastern Massachusetts, USA, 2000 to 2006. Dis. Aq. Org. 88:143–155.

Bonner, W.N. 1981. Grey seal *Halichoerus grypus* Fabricus, 1791. Pages 111–144 *in*: S.H. Ridgway and R.J. Harrison (eds). Handbook of marine mammals, Vol. 2: Seals. Academic Press, London, UK.

Boskovic, R., K.M. Kovacs, M.O. Hammill and B.N. White. 1996. Geographic distribution of mitochondrial DNA haplotypes in grey seals (*Halichoerus grypus*). Can. J. Zool. 74:1787–1796.

Bowen, W.D., J.I. McMillan and W. Blanchard. 2007. Reduced population growth of gray seals at Sable Island: Evidence from pup production and age of primiparity. Mar. Mamm. Sci. 23:48–64.

Bowen, W.D., C. den Heyer, J.I. McMillan and M.O. Hammill. 2011. Pup production at Scotian Shelf grey seal (*Halichoerus grypus*) colonies in 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/066: vi + 25pp.

Breed, G.A., W.D. Bowen, J.I. McMillan and M.L. Leonard. 2006. Sexual segregation of seasonal foraging habitats in a non-migratory marine mammal. Proc. Royal Soc. B 273:2319–2326.

Breed, G.A., I.D. Jonsen, R.A. Myers, W.D. Bowen and M.L. Leonard. 2009. Sex-specific, seasonal foraging tactics of adult grey seals (*Halichoerus grypus*) revealed by state-space analysis. Ecology 90:3209–3221.

Cammen, K.M., S. Vincze, A.S. Heller, B.A. McLeod, S.A. Wood, W.D. Bowen, M.O. Hammill, W.B. Puryear, J. Runstadler, F.W. Wenzel, M. Kinnison and T.R. Frasier. 2018. Genetic diversity from pre-bottleneck to recovery in two sympatric pinniped species in the Northwest Atlantic. Cons. Gen. 19:555–569.

Chavez-Rosales, S., M.C. Lyssikatos and J. Hatch. 2018. Estimates of cetacean and pinniped bycatch in Northeast and Mid-Atlantic bottom trawl fisheries, 2012–2016. NOAA Tech. Memo. NMFS-NE-250. https://repository.library.noaa.gov/view/noaa/22937

Davies, J.L. 1957. The geography of the gray seal. J. Mamm. 38:297–310.

den Heyer, C.E., A. Mosnier, G.B. Stenson, D.S. Lidgard, W.D. Bowen and M.O. Hammill. 2022. Grey seal pup production in Canada. DFO Can. Sci. Advis. Sec. Res Doc. 2022/nnn

den Heyer, C.E., W.D. Bowen, J. Dale, J-F. Gosslein, M.O. Hammill, D.W. Johnston, S.L.C. Lang, K. Murray, G.B. Stenson and S.A. Wood. 2020. Contrasting trends in gray seal (*Halichoerus grypus*) pup production throughout the increasing northwest Atlantic metapopulation. Mar Mamm Sci. https://doi/10.1111/mms.12773

den Heyer, C.E., S.L.C. Lang, W.D. Bowen and M.O. Hammill. 2017. Pup production at Scotian Shelf grey seal (*Halichoerus grypus*) colonies in 2016. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/056. v + 34 p.

DFO [Department of Fisheries and Oceans]. 2022. Stock assessment of Northwest Atlantic grey seals (*Halichoerus grypus*) in Canada in 2021. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2022/018.

DFO [Department of Fisheries and Oceans]. 2011. Stock assessment of Northwest Atlantic grey seals (*Halichoerus grypus*), Can. Sci. Advis. Sec. Advis. Rep. 2010/091. 12pp.

DFO [Department of Fisheries and Oceans]. 2013. Stock assessment of Northwest Atlantic grey seals (*Halichoerus grypus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/008. 11pp.

DFO [Department of Fisheries and Oceans]. 2014. Stock assessment of Canadian grey seals (*Halichoerus grypus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/010. 13pp.

DFO [Department of Fisheries and Oceans]. 2017. Stock assessment of Canadian Northwest Atlantic grey seals (*Halichoerus grypus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/045. 13pp.

Gilbert, J.R., G.T. Waring, K.M. Wynne and N. Guldager. 2005. Changes in abundance and distribution of harbor seals in Maine, 1981–2001. Mar. Mamm. Sci. 21: 519–535.

Hammill, M.O., C.E. den Heyer, W.D. Bowen and S.L.C. Lang. 2017. Grey seal population trends in Canadian waters, 1960–2016 and harvest advice. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/052. v+30pp.

Harvey, V., S.D. Côté and M.O. Hammill 2008. The ecology of 3-D space use in a sexually dimorphic mammal. Ecography 31:371–380.

Harwood, J. and J.H. Prime. 1978. Some factors affecting the size of British grey seal populations. J. Appl. Ecol. 15: 401–411.

Haug, T., M.O. Hammill and D. Ólafsdóttir (eds). 2007. Grey seals in the North Atlantic and the Baltic. NAMMCO Scientific Publications 6:7–12.

Iruzun Martins, M.C., L. Sette, E. Josephson, A. Bogomolni, K. Rose, S. Sharp, M. Niemeyer and M. Moore. 2019. Unoccupied aerial system assessment of entanglement in Northwest Atlantic gray seals (*Halichoerus grypus*). Marine Mammal Science, 35:1613–1624. https://doi.org/10.1111/mms.12590

Josephson, E., and M.C. Lyssikatos. 2023. Serious injury determinations for small cetaceans and pinnipeds caught in commercial fisheries off the northeast U.S. coast, 2017–2021. Northeast Fish. Sci. Cent. Ref. Doc.23-11. 36pp.

Katona, S.K., V. Rough and D.T. Richardson. 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. Smithsonian Institution Press, Washington, DC. 316pp.

Klimova, A., C.D. Phillips, K. Fietz, M.T. Olsen, J. Harwood, W. Amos and J.I. Hoffman 2014. Global population structure and demographic history of the grey seal. Mol. Ecol. 23(16):3999–4017.

Laviguer, L. and M.O. Hammill. 1993. Distribution and seasonal movements of grey seals, *Halichoerus grypus*, born in the Gulf of St. Lawrence and eastern Nova Scotia shore. Can. Field-Nat. 107:329–340.

Lesage, V. and M.O. Hammill. 2001. The status of the grey seal, *Halichoerus grypus*, in the Northwest Atlantic. Can. Field-Nat. 115:653–662.

Lelli, B., D.E. Harris and A-M. Aboueissa. 2009. Seal bounties in Maine and Massachusetts, 1888 to 1962. Northeast. Nat. 16:239–254.

Lyssikatos, M. and S. Chavez-Rosales. 2022. Estimation of cetacean and pinniped bycatch in northeast and mid-Atlantic bottom trawl fisheries, 2015–2019. NOAA Tech. Memo. NMFS-NE-281.

Mansfield, A.W. 1966. The grey seal in eastern Canadian waters. Can. Audubon Mag. 28:161–166.

Mohn, R. and W.D. Bowen. 1996. Grey seal predation on the eastern Scotian Shelf: Modeling the impact on Atlantic cod. Can. J. Fish. Aquat. Sci 53:2722–2738.

Moxley, J.H., A. Bogomolni, M.O. Hammill, K.M.T. Moore, M.J. Polito, L. Sette, B. Sharp, G.T. Waring, J.R. Gilbert, P.N. Halpin and D.W. Johnston. 2017. Google Haul Out: Earth observation imagery and digital aerial surveys in coastal wildlife management and abundance estimation. BioScience, 67:760–768.

Murray, K.T., J.M Hatch, R.A. DiGiovanni Jr. and E. Josephson. 2021. Tracking young-of-the-year gray seals *Halichoerus grypus* to estimate fishery encounter risk. Mar. Ecol. Prog. Ser. 671:235-245.

Muto, M.M., V.T. Helker, B.J. Delean, N.C Young, J.C. Freed, R.P. Angliss, N.A. Friday, P.L. Boveng, J.M. Breiwick, B.M. Brost, et al. 2021. Alaska marine mammal stock assessments, 2020. US Dept Commer NMFS-AFSC Tech Memo 441. 295 p.

NMFS [National Marine Fisheries Service]. 2023. Procedural Directive: Guidelines for Preparing Stock Assessment Reports Pursuant to the Marine Mammal Protection Act. NMFS Procedure 02-204-01.

NMFS [National Marine Fisheries Service]. 2023. Procedural Directive: Guidelines for Distinguishing Serious from Non-Serious Injury Pursuant to the Marine Mammal Protection Act. NMFS Procedure 02-238-01.

Nowak, B.V.R., W.D. Bowen, K.Whoriskey, D.C. Lidgard, J.E. Mills Flemming and S.J. Iverson. 2020. Foraging behavior of a continental shelf marine predator, the grey seal (*Halichoerus grypus*), is associated with in situ, subsurface oceanographic conditions. Movement Ecology 8:41.

O'Boyle, R. and M. Sinclair. 2012. Seal-cod interactions on the eastern Scotian Shelf: Reconsideration of modeling assumptions. Fisheries Research 115-116:1-13.

Olsen, M.T., A. Galatius, V. Biard, K. Gregersen and C.C. Kinze. 2016. The forgotten type specimen of the grey seal [*Halichoerus grypus* (Fabricius, 1791)] from the island of Amager, Denmark. Zoo. J. Linnean Soc. 178:713–720.

Orphanides, C.D. 2021. Estimates of cetacean and pinniped bycatch in the 2018 New England sink and Mid-Atlantic gillnet fisheries. Northeast Fish. Sci. Cent. Ref. Doc. 21-01. 16pp.

Pace, R.M., E. Josephson, S. Wood and K. Murray. 2019. Trends and patterns of seal abundance at haul-out sites in a gray seal recolonization zone. Northeast Fish. Sci Center Technical Memorandum. NMFS-NE-251. 23pp.

Precoda, K. and C.D. Orphanides. 2022. Estimates of cetacean and pinniped bycatch in the 2019 New England sink and Mid-Atlantic gillnet fisheries. Northeast Fish. Sci. Cent. Ref. Doc. 22-05. 21pp.

Precoda, K. 2023. Estimates of cetacean and pinniped bycatch in the New England and Mid-Atlantic gillnet fisheries in 2020 and 2021. Northeast Fish. Sci. Cent. Ref. Doc. 23-10. 25pp.

Precoda, K. 2024. Estimates of cetacean and pinniped bycatch in the New England and Mid-Atlantic gillnet fisheries, 2022. Northeast Fish. Sci. Cent. Ref. Doc. 24-06. 20pp.

Precoda, K. and M.C. Lyssikatos. 2024. Estimates of cetacean and pinniped bycatch in the Northeast and Mid-Atlantic bottom trawl fisheries, 2022. Northeast Fish. Sci. Cent. Ref. Doc. 24-05. 15pp.

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

Rough, V. 1995. Gray seals in Nantucket Sound, Massachusetts, winter and spring, 1994. Final report to Marine Mammal Commission. Contract T10155615. 28pp.

Thomas, L., D.J.F. Russell, C.D. Duck, C.D. Morris, M. Lonergan, F. Empacher, D. Thompson and J. Harwood. 2019. Modelling the population size and dynamics of the British grey seal. Aquatic Conserv: Mar. Freshw. Ecosyst. 29(S1):6–23.

Thomas, L., M.O. Hammill and W.D. Bowen. 2011. Estimated size of the Northwest Atlantic grey seal population, Can. Sci. Advis. Sec. Res. Doc. 2011/017. 23pp.

Trzcinski, M.K., R. Mohn and W.D. Bowen. 2005. Estimation of grey seal population size and trends at Sable Island. DFO Research Document 2005/067. Canadian Department of Fisheries and Oceans. Ottawa, Ontario, Canada. 10pp. http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ResDocs-DocRech/2005/2005_067_e.htm

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

Wood, S.A., K.T. Murray, E. Josephson and J.R. Gilbert. 2020. Rates of increase in gray seal (*Halichoerus grypus atlantica*) pupping at recolonized U.S. sites, 1988–2019. J. of Mamm. 101(1):121–128.

Wood, S.A., S. Brault and J.R. Gilbert. 2007. 2002 aerial survey of grey seals in the northeastern United States. Pages 117–121 *in*: T. Haug, M. Hammill and D. Ólafsdóttir (eds). Grey seals in the North Atlantic and Baltic. NAMMCO Sci. Pub. 6, Tromsø, Norway.

Wood, S.A., T.R. Frasier, B.A. McLeod, J.R. Gilbert, B.N. White, W.D. Bowen, M.O. Hammill, G.T. Waring and S. Brault. 2011. The genetics of recolonization: An analysis of the stock structure of grey seals (*Halichoerus grypus*) in the Northwest Atlantic. Can. J. Zool. 89:490–497.

Wood, S.A., E. Josephson, K. Precoda, and K.T. Murray. 2022. Gray seal (*Halichoerus grypus*) pupping trends and 2021 population estimates in U.S. waters. US Dept Commer Northeast Fish Sci Cent Ref Doc 22-14; 16p.

Appendix I: Estimated mortality and serious injury (M/SI) of Western North Atlantic marine mammals listed by U.S. observed fisheries. Marine mammal species with zero (0) observed M/SI are not shown in this table. (unk = unknown).

Note: Stocks not updated for this 2024 report, are included with the most recent year reported.

Category, Fishery, Species	Years Observed	Observer Coverage	Est. SI by Year (CV)	Est. Mortality by Year (CV)	Mean Annual Mortality (CV)	PBR
CATEGORY I						
Gillnet Fisheries: Northeast Gillnet						
Harbor Porpoise	2018-2022	.11, .12, .02, .11, .15	0, 0, 0, 0,0	92 (.52), 195(.22), 121 (.22), 111 (.19), 118(.22)	127 (.12)	649
Common Dolphin	2017-2021	.12, .11, .12, .02, .11	0, 0, 0, 0, 0	133 (.28), 93 (.45), 5 (.68), 50 (.25), 39 (.24)	64 (.12)	599
Risso's Dolphin	2017-2021	.12, .11, .12, .02, .11	0, 0, 0, 0, 0	0, 0, 5 (.7), 2 (1.01), 3 (0)	2.0 (1.8)	307
Bottlenose Dolphin, Offshore	2015-2019	.14, .10, .12, .11, .12	0, 0, 0, 0, 0	0, 0, 8 (.92), 0, 0	2.0 (.46)	561
Harbor Seal	2015-2019	.14, .10, .12, .11, .12	0, 0, 0, 0, 0	474 (.17), 245 (.29), 298 (.18), 188 (.36), 316 (.15)	304 (.10)	2,006
Gray Seal	2018-2022	.11, .12, .02, .11, .15	0, 0, 0, 0, 6	1113 (.32), 2019 (.17), 1357 (.14), 1027 (.14), 516(.12)	1,208 (.09)	756
Harp Seal	2015-2019	.14, .10, .12, .11, .12	0, 0, 0, 0, 0	119 (.34), 85 (.50), 44 (.37), 14 (.8), 163 (.19)	85 (.16)	unk
Atlantic White-sided Dolphin	2017-2021	.12, .11, .12, .02, .11	0, 0, 0, 0, 0	0, 0, 0. 0, 2 (NA)	.2 (NA)	544
Gillnet Fisheries: US Mid-Atlantic Gillnet						
Harbor Porpoise	2018-2022	.09, .13, .03, .01, .02	0, 0, 0, 0, 0	0, 13 (.51), 16 (.63), 10 (.65), 12(.66)	10(.39)	649
Common Dolphin	2017-2021	.09, .09, .13, .03, .01	11, 1, 0, 5, 4	11 (.71), 8 (.91), 20 (.56), 25 (.55), 20 (.33)	21 (.33)	599
Harp Seal	2015-2019	.06, .08, .09, .09, .13	0, 0, 0, 0, 0	0, 0, 0, 0, 29 (.84)	6 (4.2)	unk
Harbor Seal	2015-2019	.06, .08, .09, .09, .13	0, 0, 0, 0, 0	48 (.52), 18 (.95), 3 (.18), 26 (.52), 17 (.35)	22 (.30)	2,006
Gray Seal	2018-2022	.09, .13, .03, .01, .02	0, 0, 0, 0, 0	0, 18 (.40), 9 (.72), 7(.69), 8(.81)	8.0(0.38)	756
Longline Fisheries: Pelagic Longline (Excluding NED-E)						
Risso's Dolphin	2017-2021	.12, .10, .10, .09, .08	0.2 (1), 0.2 (.94), 0, 12 (.71), 0	0, 0, 0, 0, 0	2.5 (.68)	307
Short-finned Pilot Whale	2017-2021	.12, .10, .10, .09, .08	133 (.29), 102 (.39), 131 (.37), 371 (.45), 332 (.31)	0, 0, 0, 0, 23	218 (.19)	143
Long-finned Pilot Whale	2017-2021	.12, .10, .10, .09, .08	3.3 (.98), 0.4 (.93), 0.4 (1), 5.7 (.44), 2.8 (.67)	0, 0, 0, 0, 0	2.5 (.36)	306
Common Dolphin	2017-2021	.12, .10. .10, .09, .08	4.9 (1), 1.4 (1), 0, 0, 0	0, 0, 0, 0, 0	1.3 (.81)	599

Category, Fishery, Species	Years Observed	Observer Coverage	Est. SI by Year (CV)	Est. Mortality by Year (CV)	Mean Annual Mortality (CV)	PBR
CATEGORY II						
Trawl Fisheries: Northeast Bottom Trawl						
Harp Seal	2015-2019	.19, .12, .12, .12, 16	0, 0, 0, 0, 0	0, 0, 0, 0, 5.4 (.89)	1.1 (.89)	unk
Harbor Seal	2015-2019	.19, .12, .12, .12, 16	0, 0, 0, 0, 0	0, 0, 8.3 (.96), 0, 5.4 (.88)	2.7 (.68)	2,006
Gray Seal	2018-2022	.12, 16, .08, .19, .28	0, 0, 0, 0, 0	16 (.24), 32 (.42), 30 (.37), 26 (.26), 7.5 (.6), 25(.22)	24 (.15)	756
Risso's Dolphin	2017-2021	.12, .12, 16	0, 0, 0, 0, 0	0, 0, 0, 0 3.8 (.88)	.75 (.88)	307
Bottlenose Dolphin, Offshore	2015-2019	.19, .12, .16, .12, 16	0, 0, 0, 0, 0	19 (.65), 34 (.89), 0, 0, 5.6 (.92)	11.5 (.56)	519
Long-finned Pilot Whale	2017-2021	.12, .12, 16, .08, .19	0, 0, 0, 0, 0	0, 0, 5.4 (.88), 1.8(.88), 7.5 (.62)	2.9 (.46)	306
Common Dolphin	2017-2021	.12, .12, 16, .08, .19	0, 0, 0, 0, 0	0, 28(.54), 10 (.62), 50 (.25), 38 (.42)	64 (.18)	599
Atlantic White-sided Dolphin	2017-2021	.12, .12, 16, .08, .19	7.4, 0, 0 5.1	15(.64), 0, 79 (.28)	27 (.21)	544
Harbor Porpoise	2018-2022	12, 16, .08, .19, .28	0, 0, 0, 0, 1	0, 0, 11 (.63), 3.6 (.63), 5.0 (.92), 0	4.8 (.9)	649
Mid-Atlantic Bottom Trawl						
Common Dolphin	2017-2021	.14, .12, .12, .02, .04	0, 5, 15, 7, 0	380 (.23), 205 (.54), 395 (.23), 237 (.14), 230 (.57)	309 (.13)	599
Risso's Dolphin	2017-2021	.14, .12, .12, .02, .04	12, 0, 0, 4, 0	31 (.51), 0, 0, 14 (.51), 0	12 (.39)	307
Bottlenose Dolphin, Offshore	2013-2017	.06, .08, .09, .10, .10	0, 0, 0, 0, 0	0, 7.3 (.93), 22 (.66), 6.3 (.91), 0	7.2 (.48)	561
Harbor Seal	2015-2019	.09, .10, .10, .12, .12	0, 0, 0, 0, 0	7, 0, 0, 6 (.94), 7.3 (.93)	4.1 (0.56)	2,006
Gray Seal	2018-2022	12, .12, .02, .04, .08	0, 0, 0, 0, 0	56 (.58), 22 (.53), 35 (.35), 0, 64(.37)	35(.32)	756
Northeast Mid-water Trawl (Including Pair Trawl)						
Harbor Seal	2015-2019	.08, .27, .16, .14, .28	0, 0, 0, 0, 0	.4 (na), .2 (na), 0, 0, 0	0.6 (na)	2,006
Gray Seal	2018-2022	.14, .28, .13, .36, .65	0, 0, 0, 0, 0	2 (na), 0, 0, 0, 0	0.2 (na)	756

Appendix II: Summary of the confirmed observed human-caused mortality and serious injury (M/SI) events involving baleen whale stocks along the Gulf of America Coast, U.S. East Coast, and adjacent Canadian Maritimes, 2018–2022, with number of events attributed to entanglements or vessel collisions by year.

Stock	Mean Annual M/SI rate (PBR[1] for reference)	Entanglements Annual Rate (U.S. waters, Canadian waters, unknown first sighted in U.S., unknown first sighted in Canada, unknown first sighted in Caribbean)	Entanglements Confirmed Mortalities (2018, 2019, 2020, 2021, 2022)	Entanglements Injury Value Against PBR (2018, 2019, 2020, 2021, 2022)	Vessel Collisions Annual Rate (U.S. waters, Canadian waters, unknown first sighted in U.S., unknown first sighted in Canada)	Vessel Collisions Confirmed Mortalities (2018, 2019, 2020, 2021, 2022)	Vessel Collisions Injury Value Against PBR (2018, 2019, 2020, 2021, 2022)	Mortality due to other human-caused sources including plastic ingestion, oil spill, etc. (2018–2022)
Western North Atlantic Right Whale ***(Eubalaena glacialis)***	5.45 (0.7)	3.95 (0.20/ 1.55/ 1.70/ 0.50/ 0.00)	(3, 1, 1, 0, 1)	(3.25, 1, 2.75, 4, 2.75)	1.50 (0.70/ 0.80/ 0.00/ 0.00)	(0, 4, 1, 1, 0)	(0, 0, 1, 0.52, 0)	0
Gulf of Maine Humpback Whale ***(Megaptera novaeangliae)***[2]	14.15 (22)	10.15 (2.05/ 0.15/ 7.20/ 0.35/ 0.4)	(3, 1, 4, 2, 2)	(8.25, 6.5, 7.5, 8.25, 8.25)	4.00 (3.30/ 0.00/ 0.70/ 0.00)	(7, 5, 3, 0, 1)	(2, 1.02, 0, 1, 0)	0
Western North Atlantic Fin Whale ***(Balaenoptera physalus)***	1.89 (11)	1.45 (0.00/ 0.60/ 0.15/ 0.7 0/ 0.00)	(1, 2, 0, 0, 1)	(0, 0, 1.5, 1.75, 0)	0.44 (0.44/ 0.00/ 0.00/ 0.00)	(1, 0, 0, 1, 1)	(0, 0, 0, 0.2, 0)	0
Nova Scotian Sei Whale ***(B. borealis)***	0.4 (6.2)	0.20 (0, 0, 0.20, 0/ 0.00)	(1, 0, 0, 0, 0)	0	0	0	0	1
Canadian East Coast Minke Whale ***(B. acutorostrata)***	7.8 (170)	7.20 (1.80/ 1.65/ 2.85/ 0.90/ 0.00)	(11, 3, 5, 2, 3)	(2.25, 3.75, 1, 1.5, 3.5)	0.60 (0.40/ 0.20/ 0.00/ 0.00)	(1, 0, 0, 1, 1)	0	0
Northern Gulf of America Rice's whale (B. Ricei)	0.3 (0.07)	0	0	0	0	0	0	(.25, 1.19, .14, , .09, .06)

[1] Potential Biological Removal (PBR)

[2] None of these SARs were updated in 2024. Values reported here are published in Henry et al. (2024) and Appendix VI (Appendix VI for Rice's whale only).

Henry, A.G., M. Garron, D. Morin, A. Smith, A. Reid, W. Ledwell and T.V.N. Cole. 2024. Serious injury and mortality determinations for baleen whale stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2018–2022.Northeast Fisheries Science Center Reference Document 24-10. https://repository.library.noaa.gov/view/noaa/66558

Appendix III: Fishery Descriptions - List of Figures

Figure 1. 2018 Northeast sink gillnet observed hauls (A) and incidental takes (B).

Figure 2. 2019 Northeast sink gillnet observed hauls (A) and incidental takes (B).

Figure 3. 2020 Northeast sink gillnet observed hauls (A) and incidental takes (B).

Figure 4. 2021 Northeast sink gillnet observed hauls (A) and incidental takes (B).

Figure 5. 2022 mid-Atlantic coastal gillnet observed hauls (A) and incidental takes (B).

Figure 6. 2018 mid-Atlantic coastal gillnet observed hauls (A) and incidental takes (B).

Figure 7. 2019 mid-Atlantic coastal gillnet observed hauls (A) and incidental takes (B).

Figure 8. 2020 mid-Atlantic coastal gillnet observed hauls (A) and incidental takes (B).

Figure 9. 2021 mid-Atlantic coastal gillnet observed hauls (A) and incidental takes (B).

Figure 10. 2022 mid-Atlantic coastal gillnet observed hauls (A) and incidental takes (B).

Figure 11. 2018 mid-Atlantic bottom trawl observed tows (A) and incidental takes (B).

Figure 12. 2019 mid-Atlantic bottom trawl observed tows (A) and incidental takes (B).

Figure 13. 2020 mid-Atlantic bottom trawl observed tows (A) and incidental takes (B).

Figure 14. 2021 mid-Atlantic bottom trawl observed tows (A) and incidental takes (B).

Figure 15. 2022 mid-Atlantic bottom trawl observed tows (A) and incidental takes (B).

Figure 16. 2018 Northeast bottom trawl observed tows (A) and incidental takes (B).

Figure 17. 2019 Northeast bottom trawl observed tows (A) and incidental takes (B).

Figure 18. 2020 Northeast bottom trawl observed tows (A) and incidental takes (B).

Figure 19. 2021 Northeast bottom trawl observed tows (A) and incidental takes (B).

Figure 20. 20212 Northeast bottom trawl observed tows (A) and incidental takes (B).

Figure 21. 2018 Northeast mid-water trawl observed tows (A) and incidental takes (B).

Figure 22. 2019 Northeast mid-water trawl observed tows (A) and incidental takes (B).

Figure 23. 2020 Northeast mid-water trawl observed tows (A) and incidental takes (B).

Figure 24. 2021 Northeast mid-water trawl observed tows (A) and incidental takes (B).

Figure 25. 20212 Northeast mid-water trawl observed tows (A) and incidental takes (B).

Figure 26. 2018 mid-Atl. mid-water trawl observed tows (A) and incidental takes (B).

Figure 27. 2019 mid-Atl. mid-water trawl observed tows (A) and incidental takes (B).

Figure 28. 2020 mid-Atl. mid-water trawl observed tows (A) and incidental takes (B).

Figure 29. 2021 mid-Atl. mid-water trawl observed tows (A) and incidental takes (B).

Figure 30. 2022 mid-Atl. mid-water trawl observed tows (A) and incidental takes (B).

Figure 31. 2018 Atlantic herring purse seine observed hauls (A) and incidental takes (B).

Figure 32. 2019 Atlantic herring purse seine observed hauls (A) and incidental takes (B).

Figure 33. 2020 Atlantic herring purse seine observed hauls (A) and incidental takes (B).

Figure 34. 2021 Atlantic herring purse seine observed hauls (A) and incidental takes (B).

Figure 35. 2022 Atlantic herring purse seine observed hauls (A) and incidental takes (B).

Figure 36. 2018 Observed sets and marine mammal interactions in the pelagic longline fishery- U.S. Atlantic coast and Gulf of America.

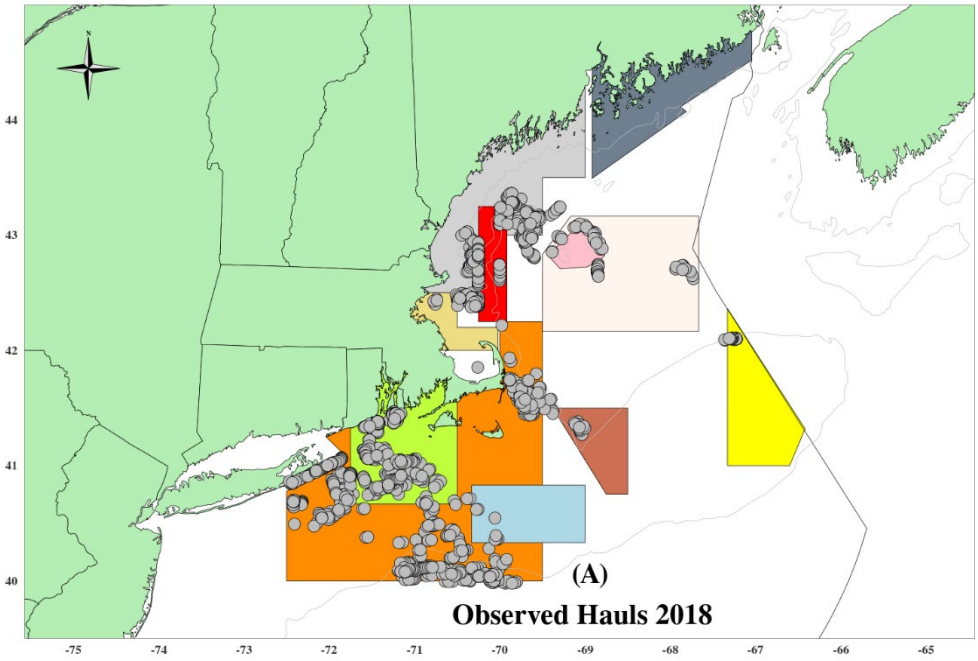
Figure 37. 2019 Observed sets and marine mammal interactions in the pelagic longline fishery- U.S. Atlantic coast and Gulf of America.

Figure 38. 2020 Observed sets and marine mammal interactions in the pelagic longline fishery- U.S. Atlantic coast and Gulf of America.

Figure 39. 2021 Observed sets and marine mammal interactions in the pelagic longline fishery- U.S. Atlantic coast and Gulf of America.

Figure 40. 2022 Observed sets and marine mammal interactions in the pelagic longline fishery - U.S. Atlantic coast and Gulf of America.

Figure 1. 2018 Northeast sink gillnet observed hauls (A) and observed takes (B).



Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closed Area

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cod South Closure | Cashes Ledge Closed Area

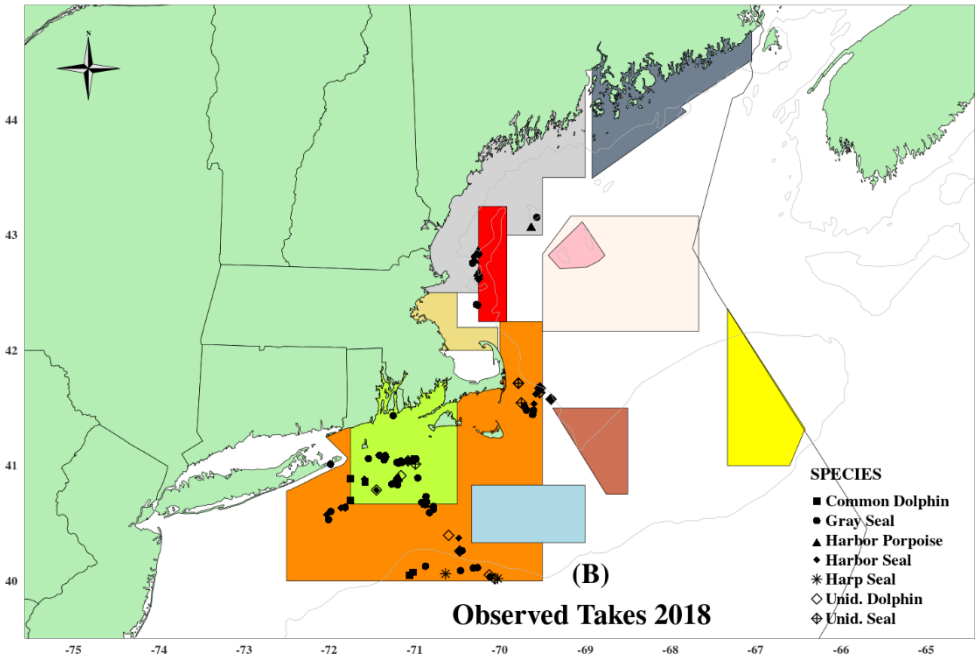
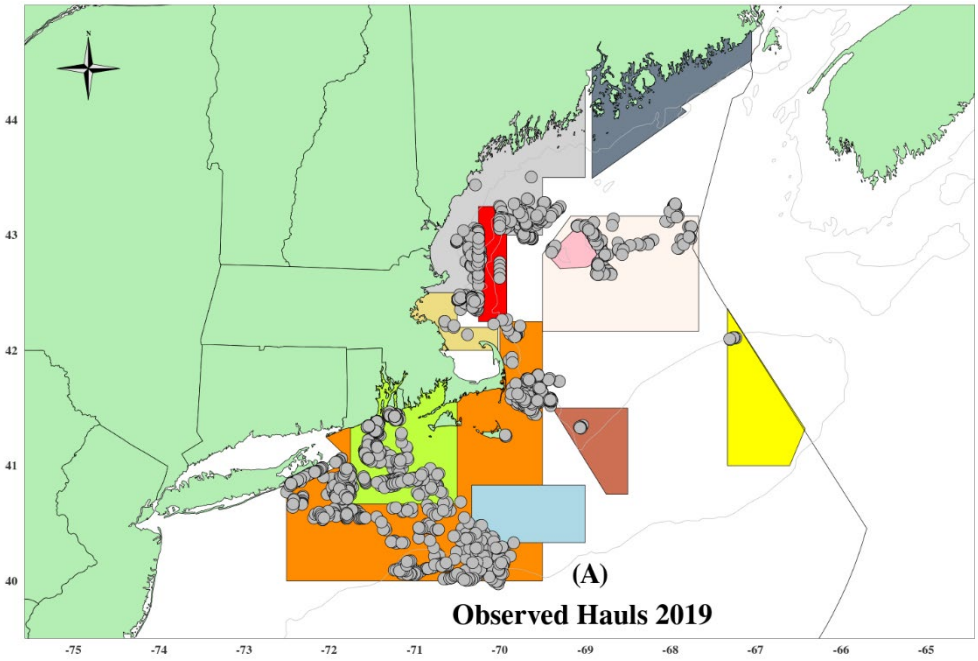


Figure 2. 2019 Northeast sink gillnet observed hauls (A) and observed takes (B).



Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closed Area

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cod South Closure | Cashes Ledge Closed Area

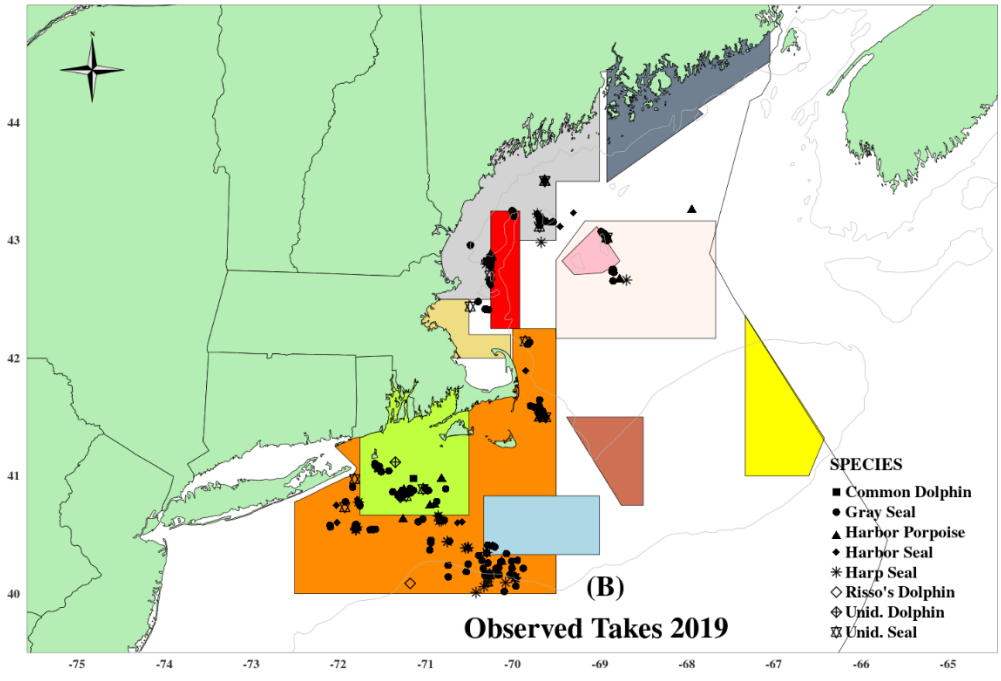
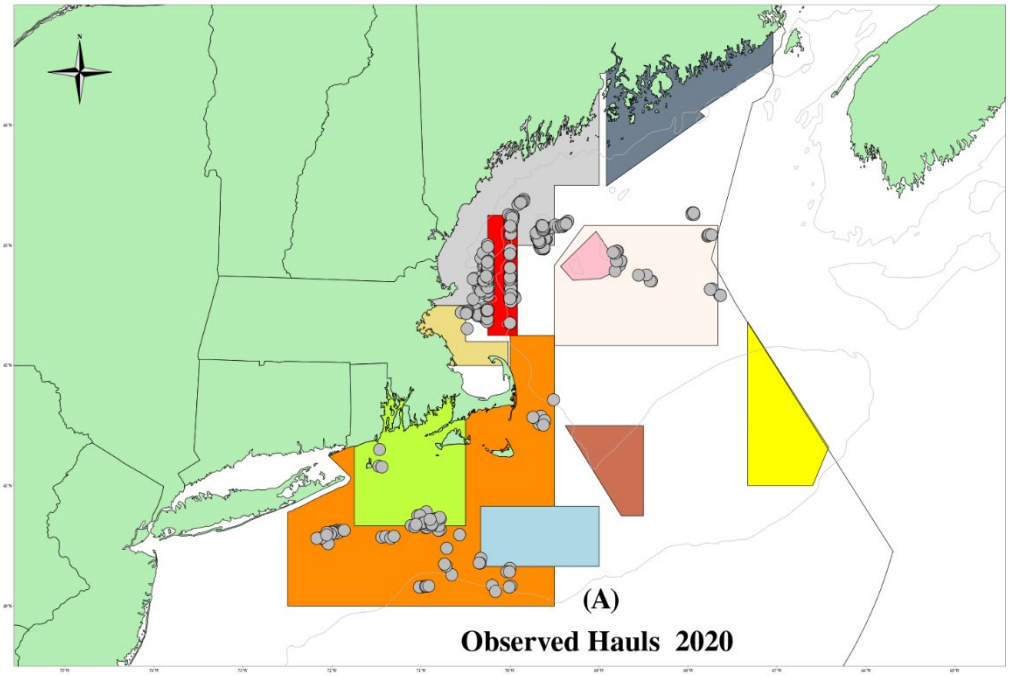


Figure 3. 2020 Northeast sink gillnet observed hauls (A) and observed takes (B).



Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closed Area

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cod South Closure | Cashes Ledge Closed Area

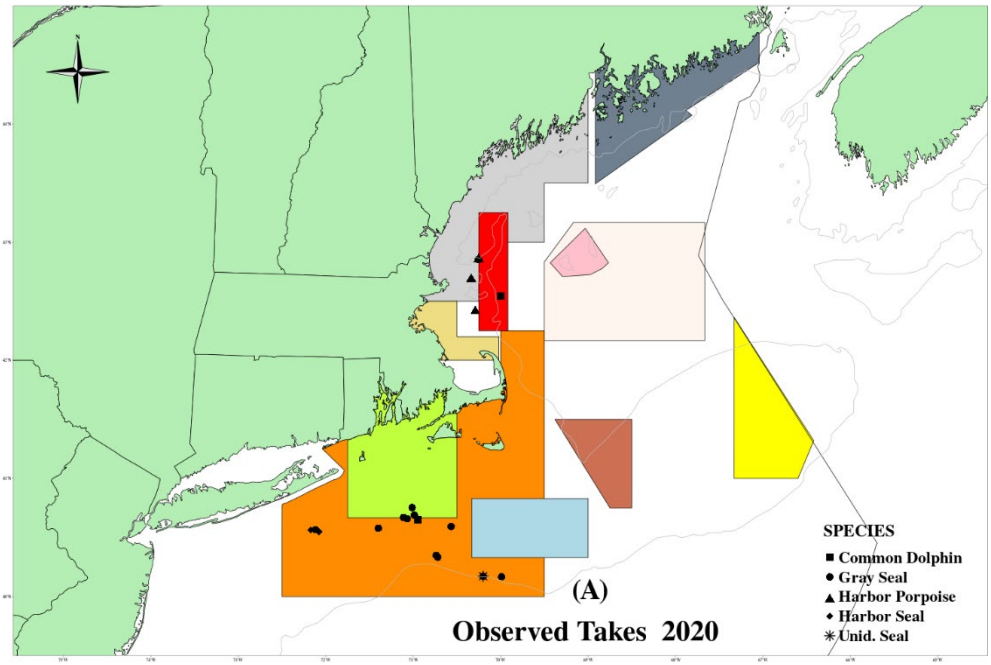


Figure 4. 2021 Northeast sink gillnet observed hauls (A) and observed takes (B).

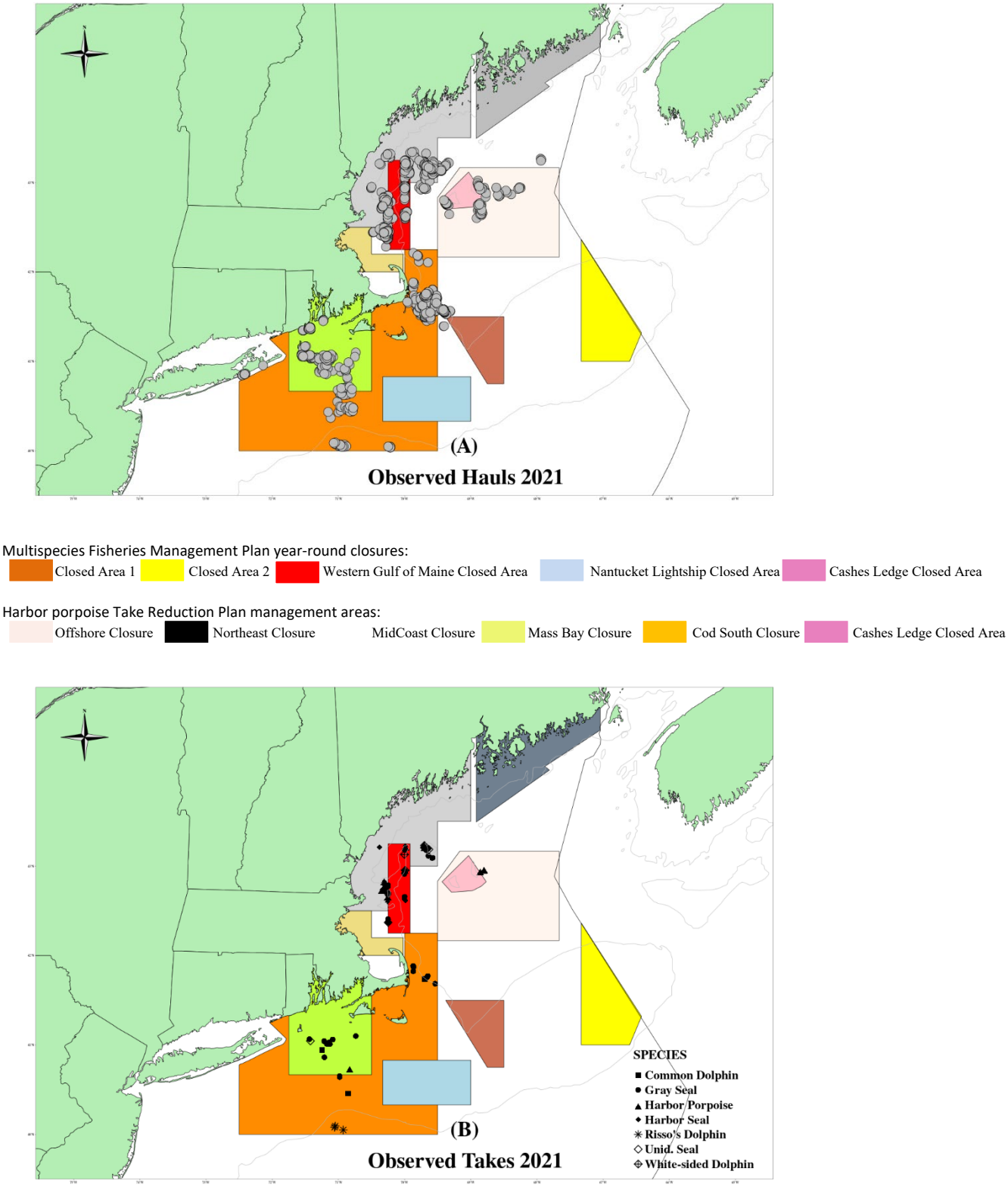
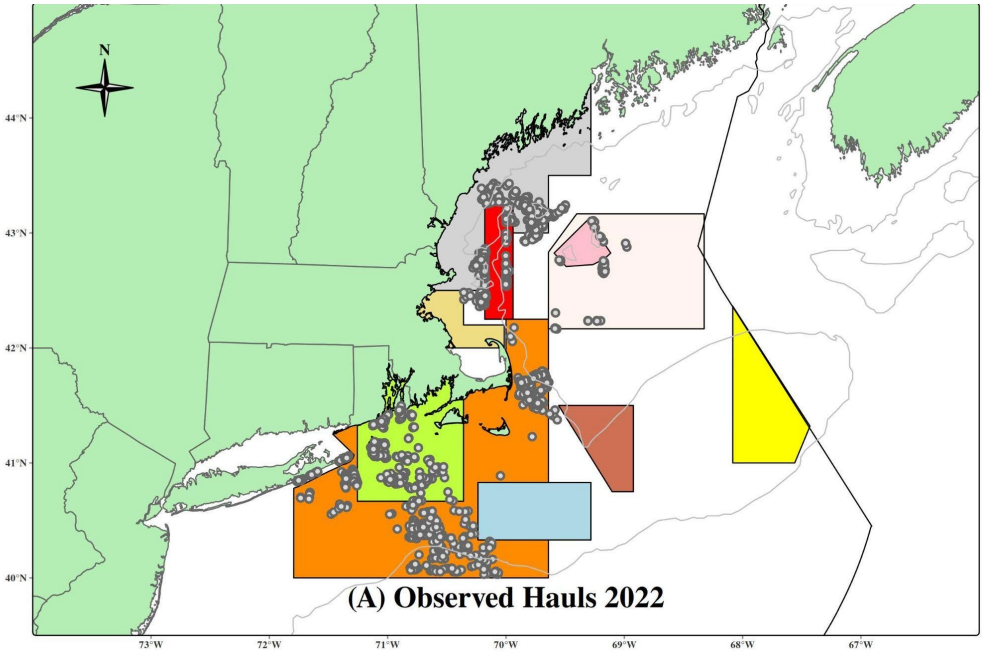


Figure 5. 2022 Northeast sink gillnet observed hauls (A) and observed takes (B).



Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closed Area

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cod South Closure | Cashes Ledge Closed Area

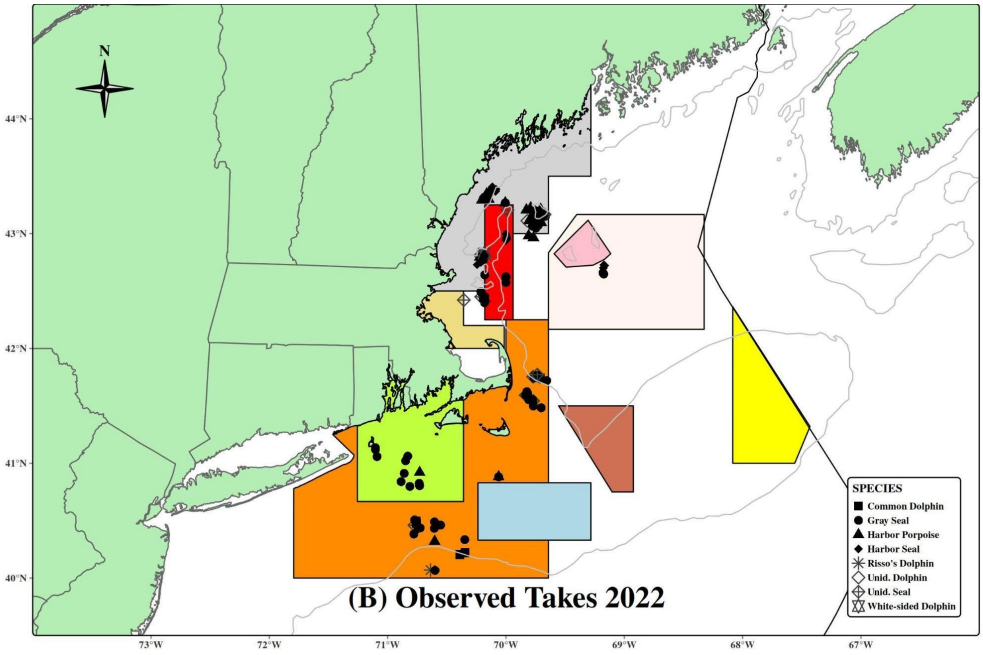
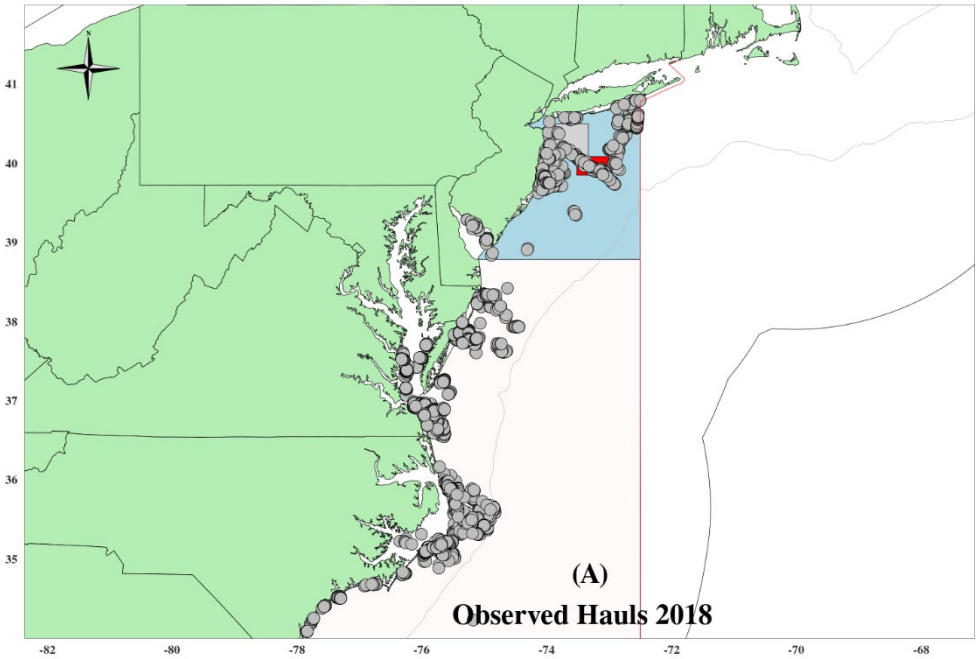


Figure 6. 2018 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

Southern mid-Atlantic waters | New Jersey Mudhole | Mudhole South | waters off New Jersey

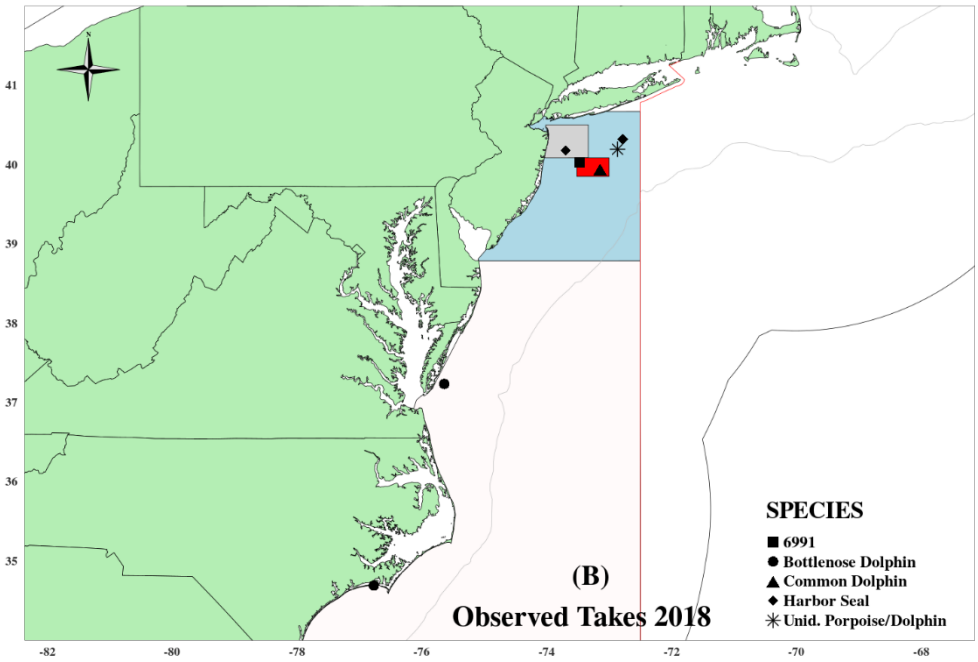
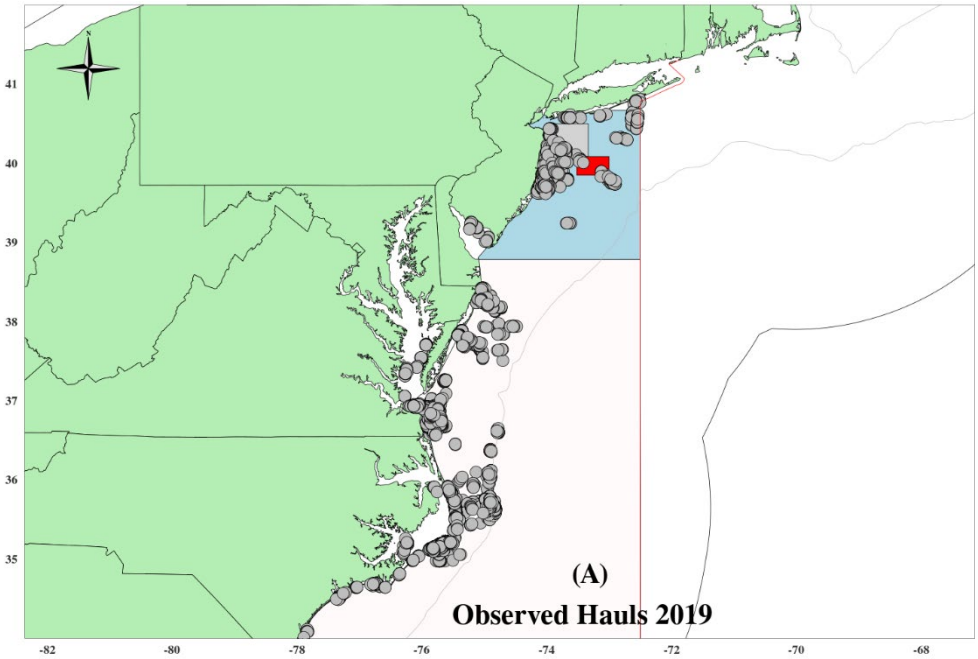


Figure 7. 2019 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

Southern mid-Atlantic waters | New Jersey Mudhole | Mudhole South | waters off New Jersey

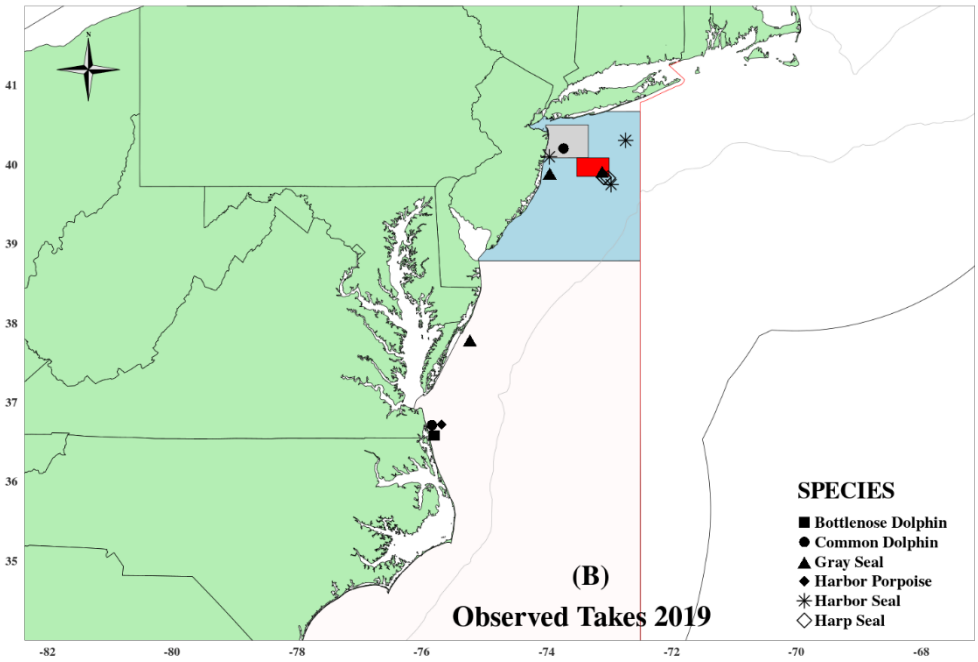
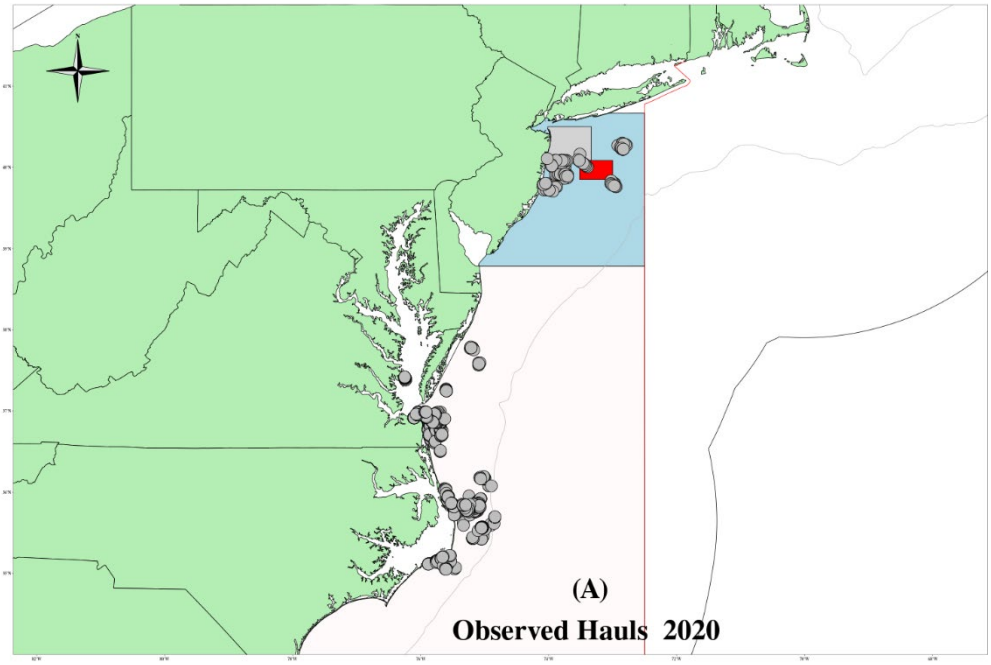


Figure 8. 2020 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:
Southern mid-Atlantic waters | New Jersey Mudhole | Mudhole South | waters off New Jersey

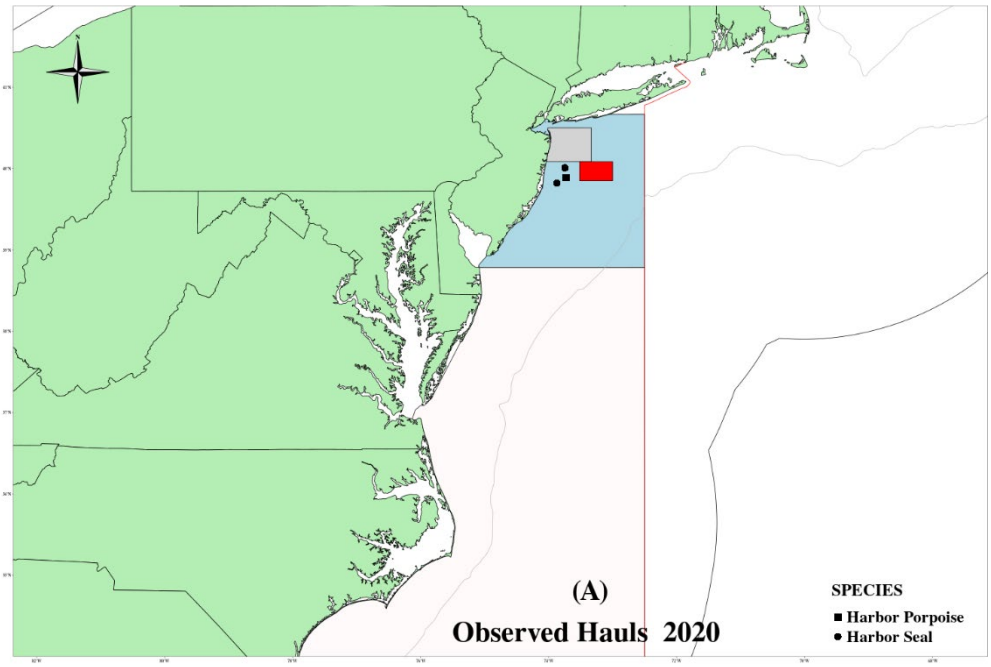
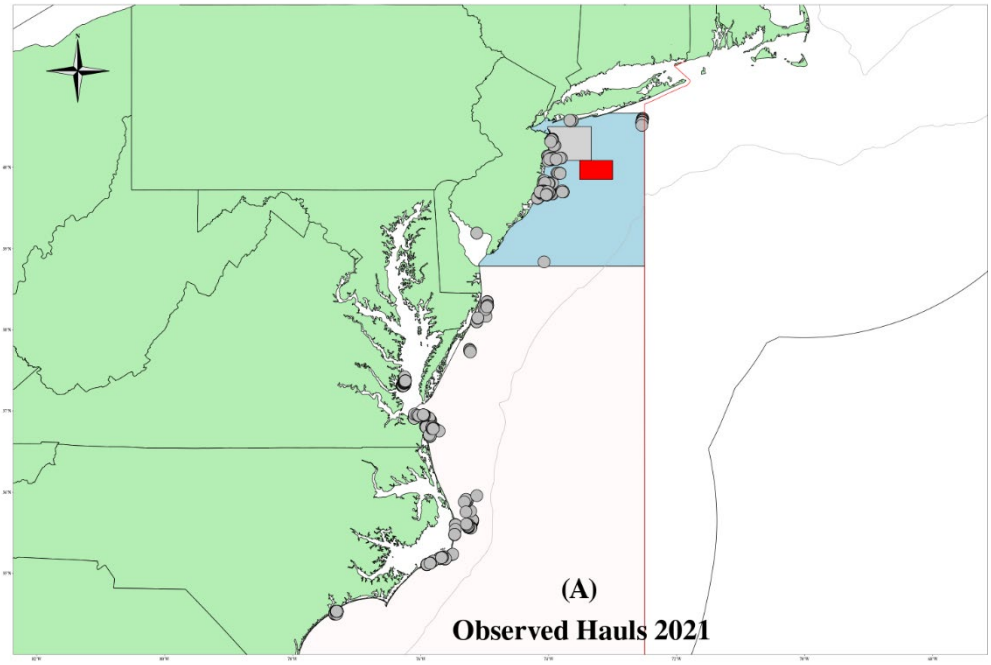


Figure 9. 2021 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:
Southern mid-Atlantic waters | New Jersey Mudhole | Mudhole South | waters off New Jersey

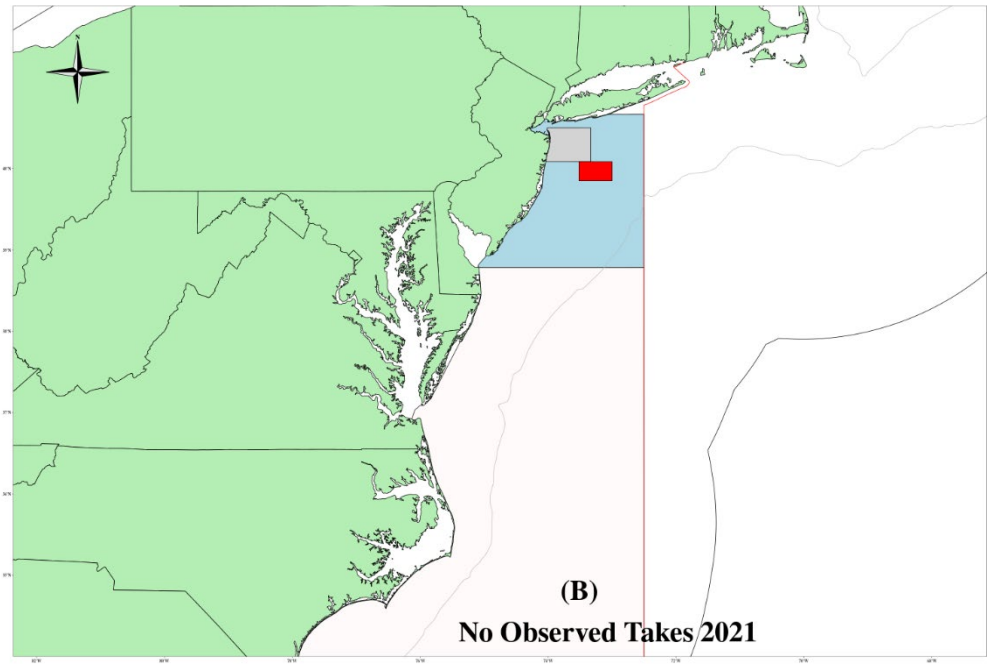
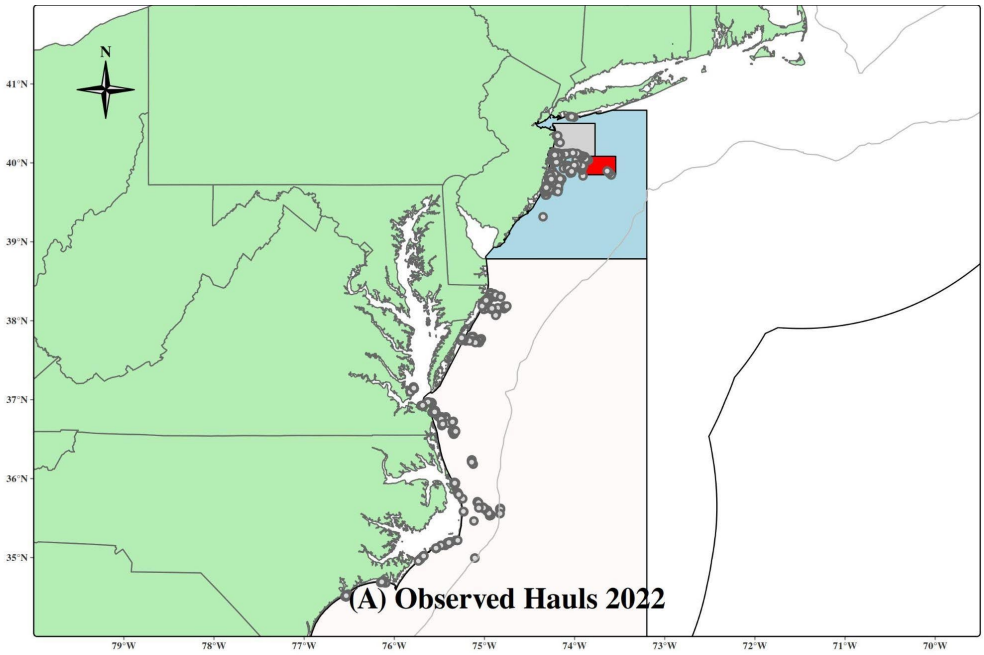


Figure 10. 2022 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:
Southern mid-Atlantic waters | New Jersey Mudhole | Mudhole South | waters off New Jersey

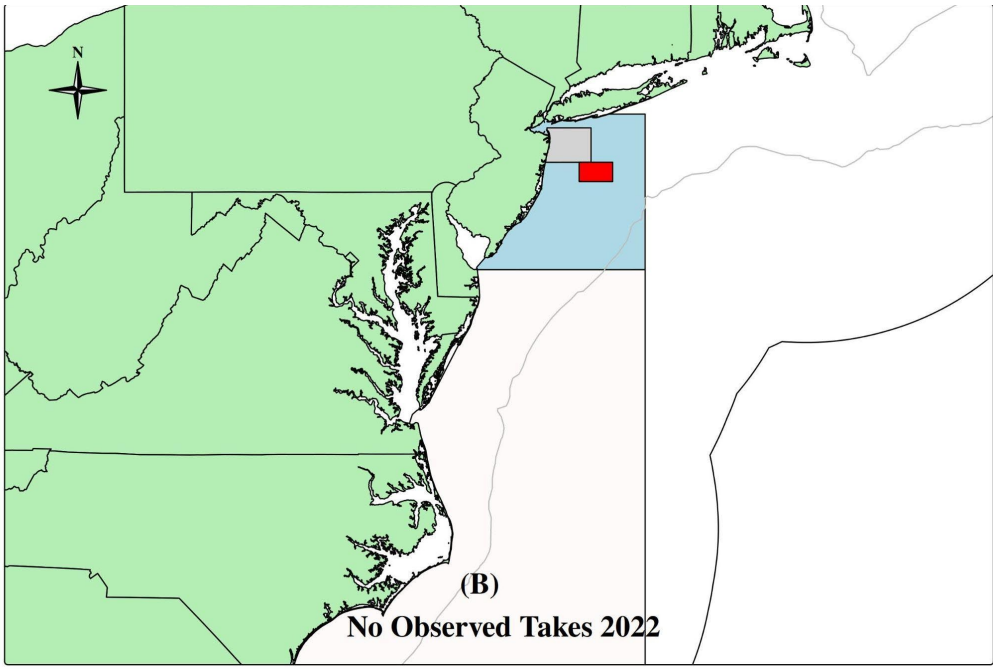


Figure 11. 2018 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

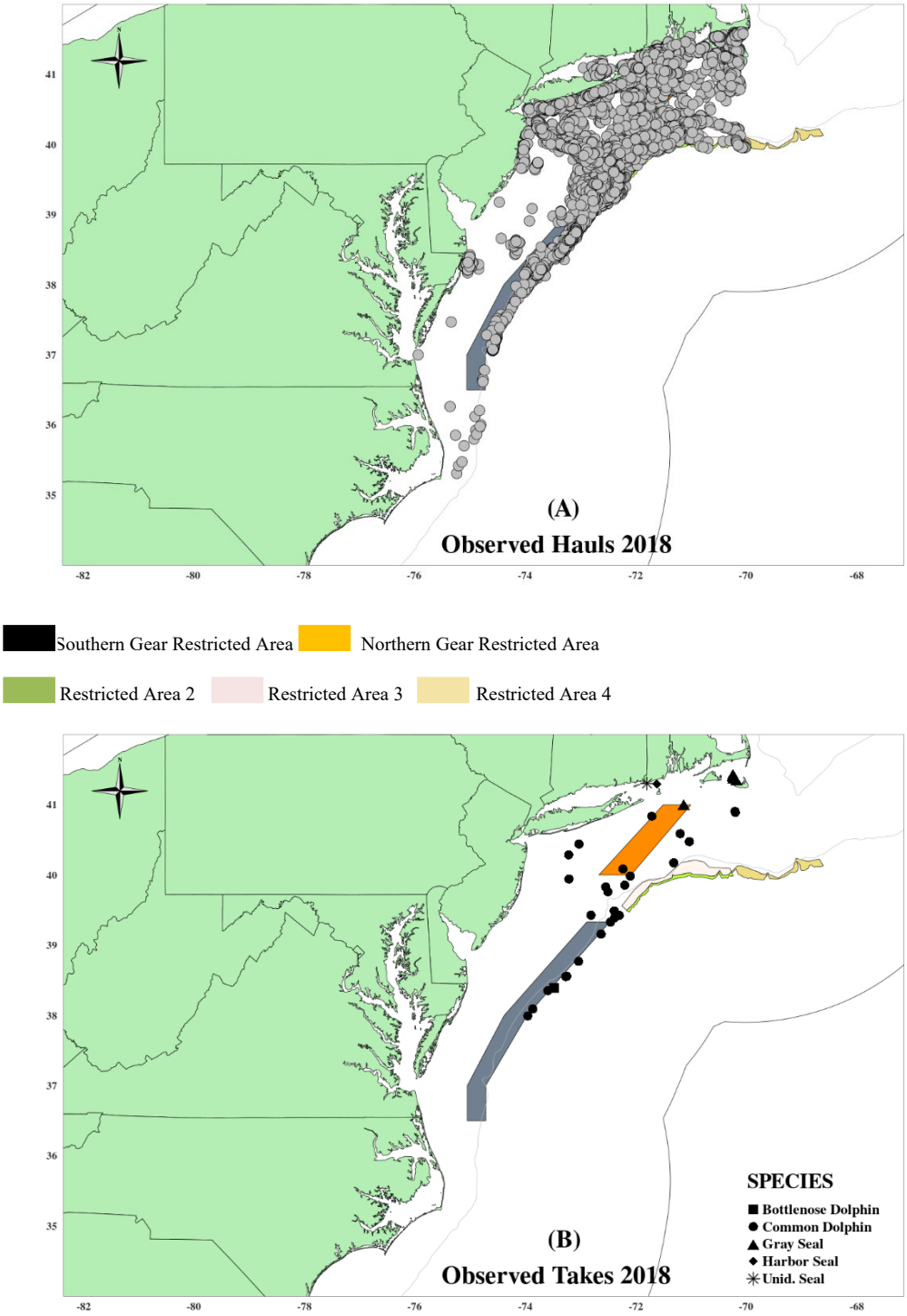


Figure 12. 2019 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

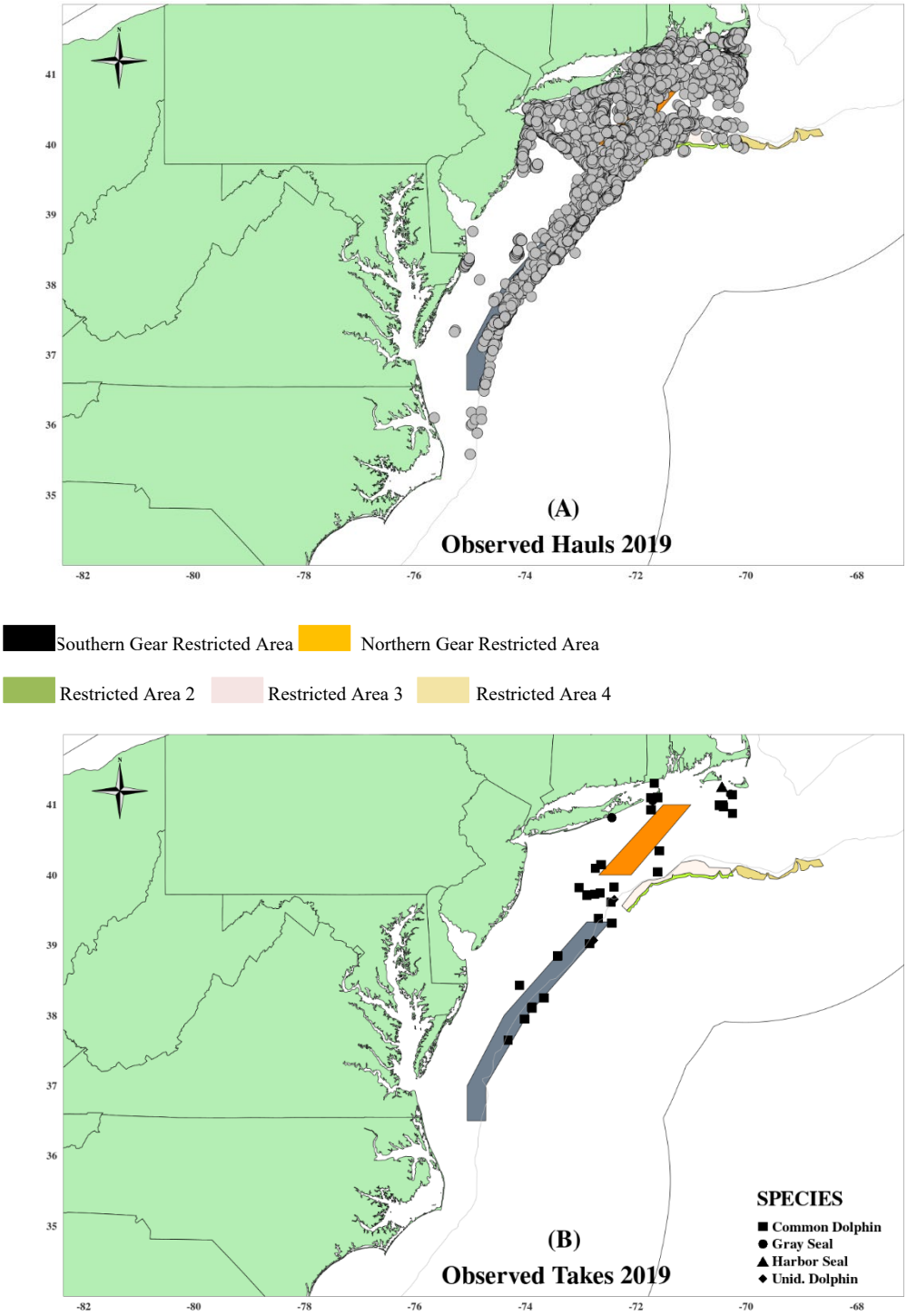
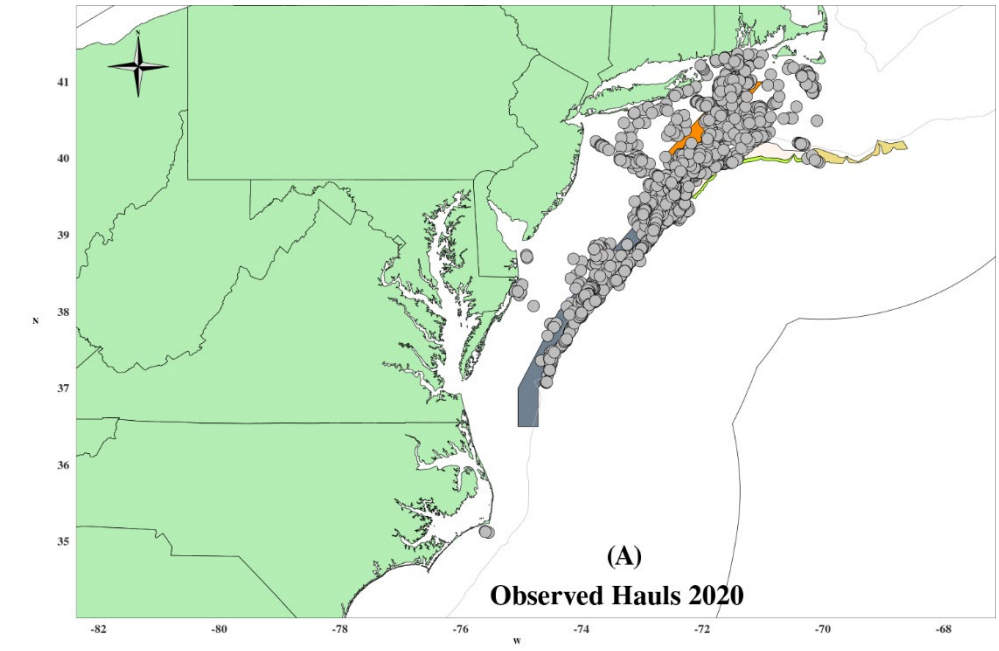


Figure 13. 2020 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).



Southern Gear Restricted Area Northern Gear Restricted Area

Restricted Area 2 Restricted Area 3 Restricted Area 4

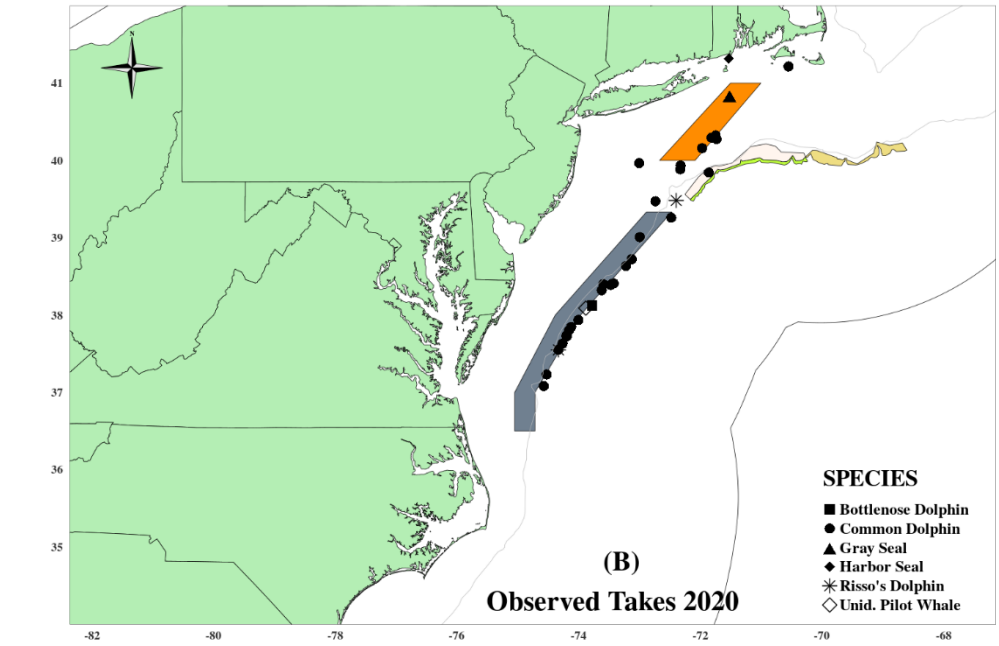


Figure 14. 2021 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

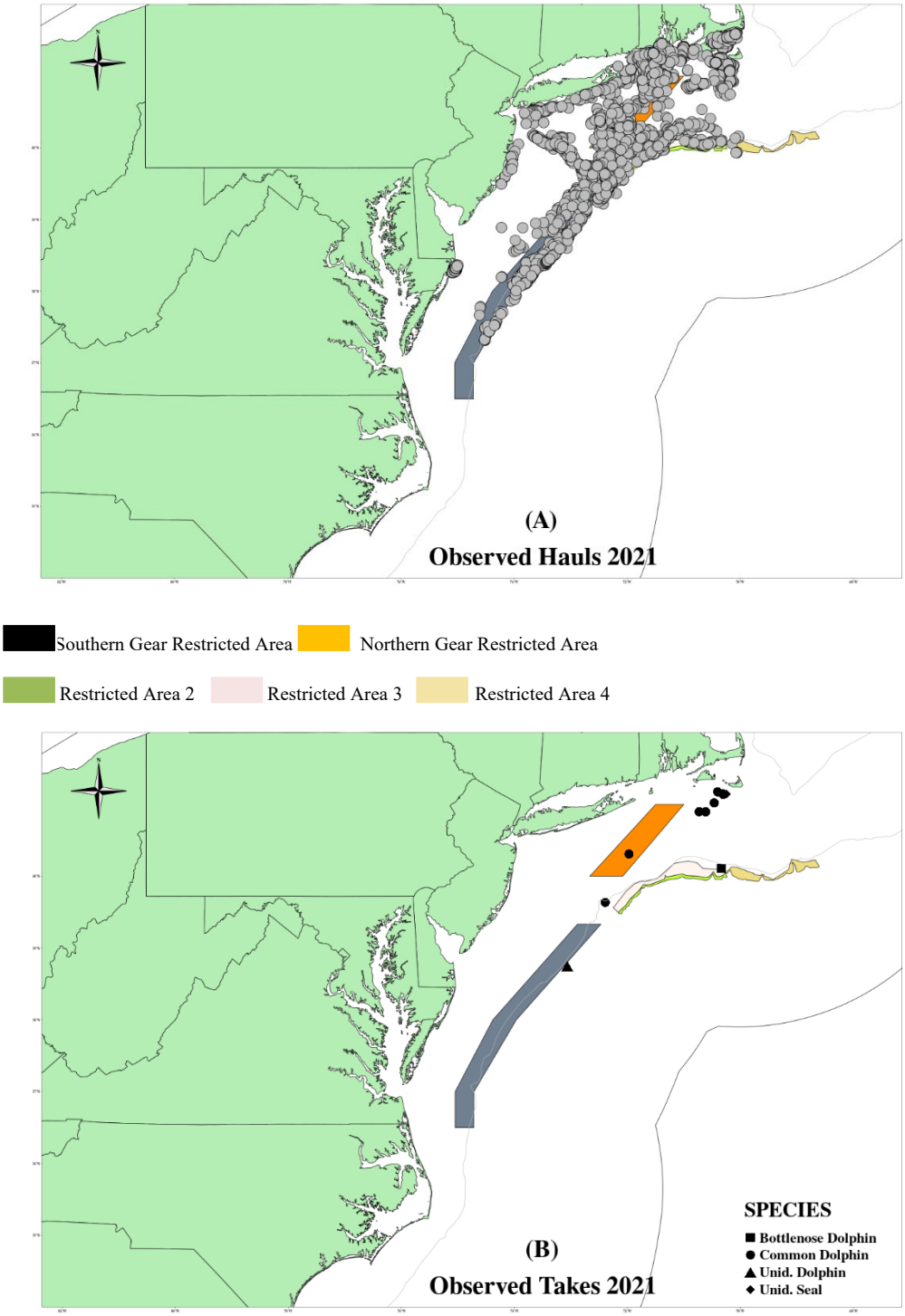
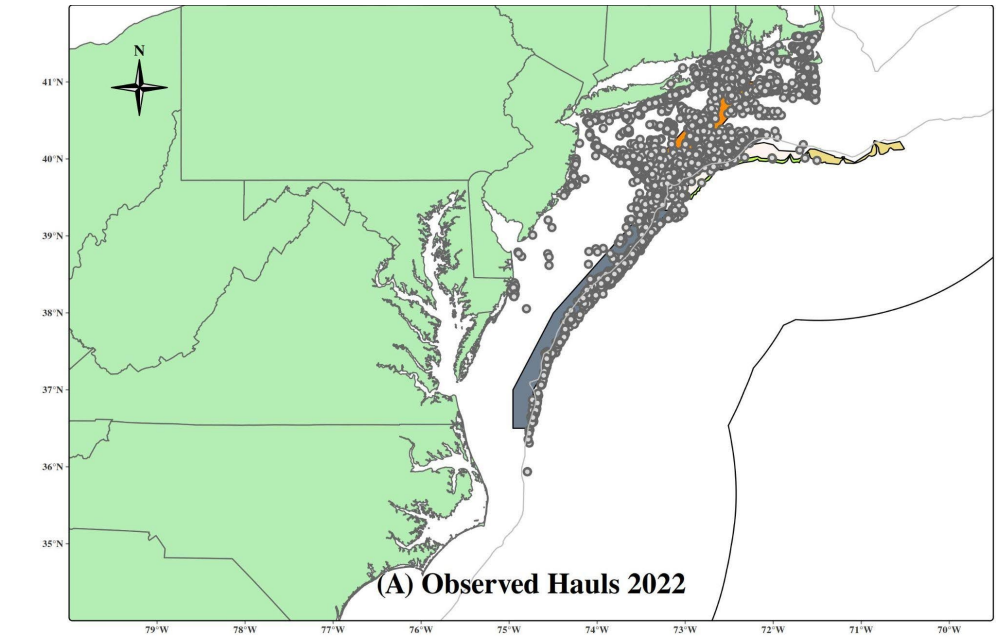


Figure 15. 2022 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).



Southern Gear Restricted Area Northern Gear Restricted Area

Restricted Area 2 Restricted Area 3 Restricted Area 4

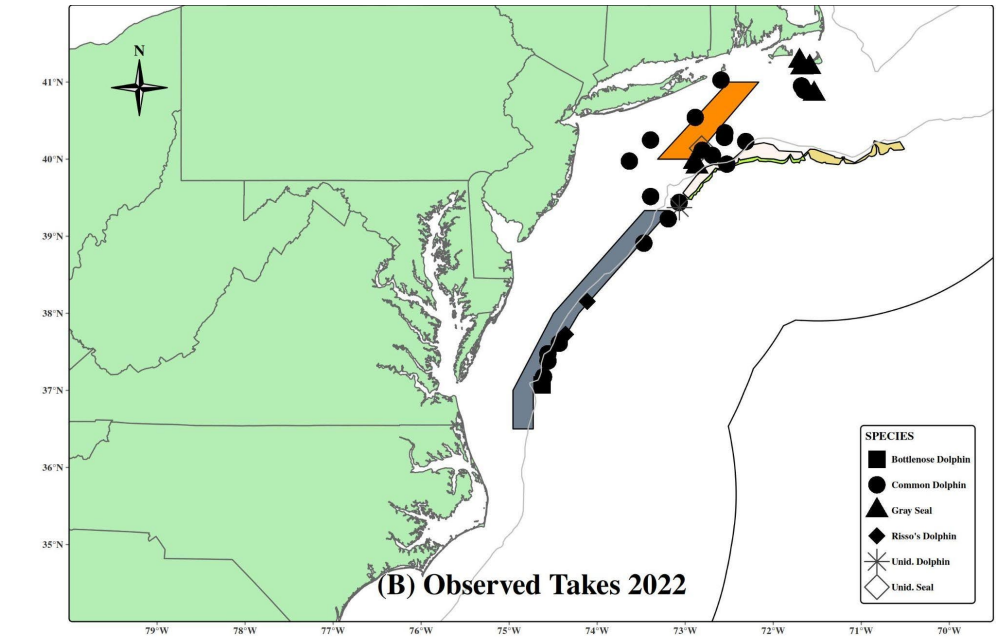
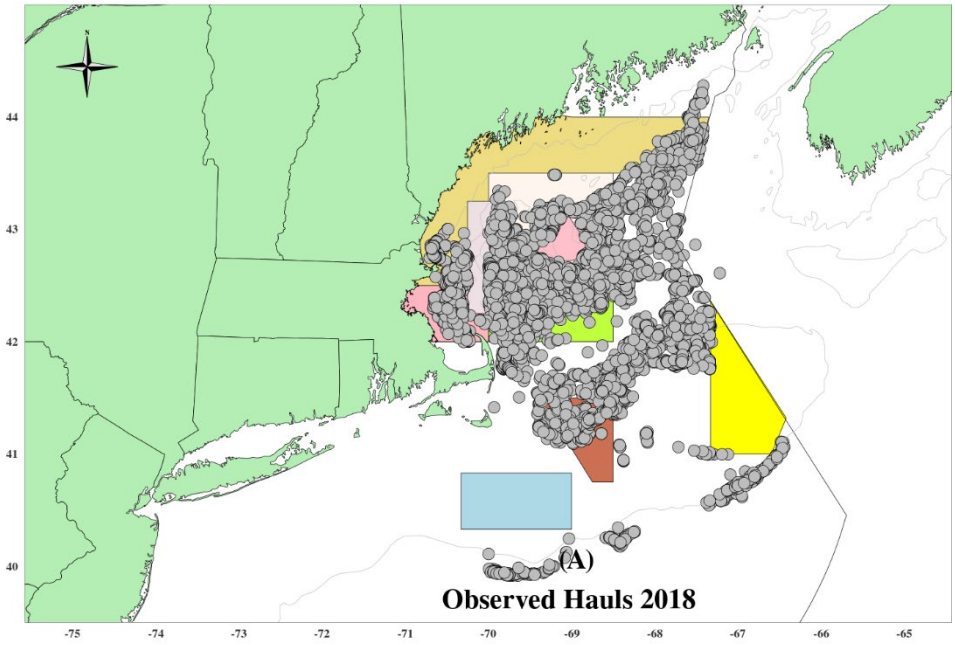
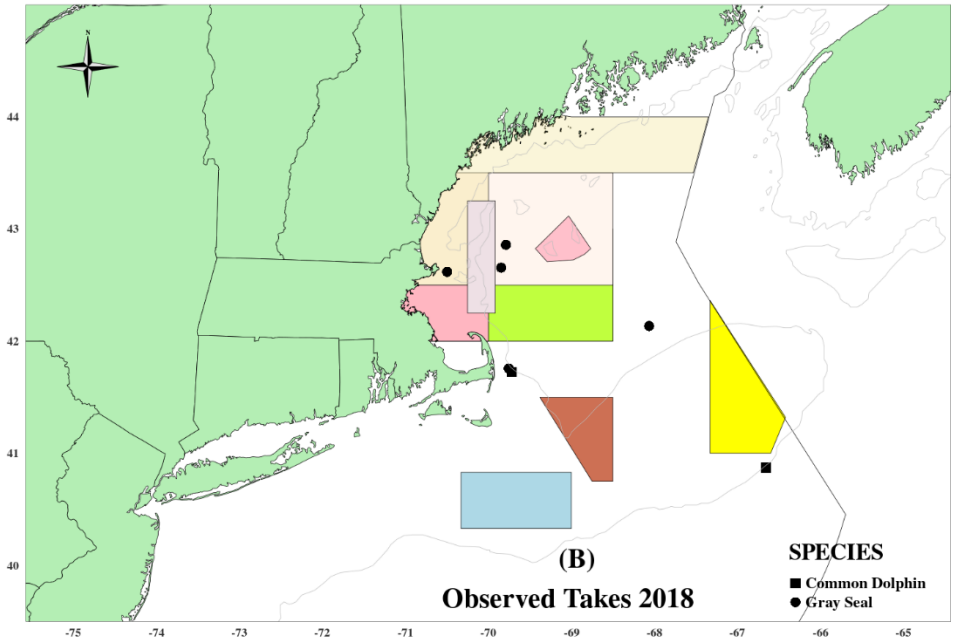


Figure 16. 2018 Northeast bottom trawl observed tows (A) and observed takes (B).

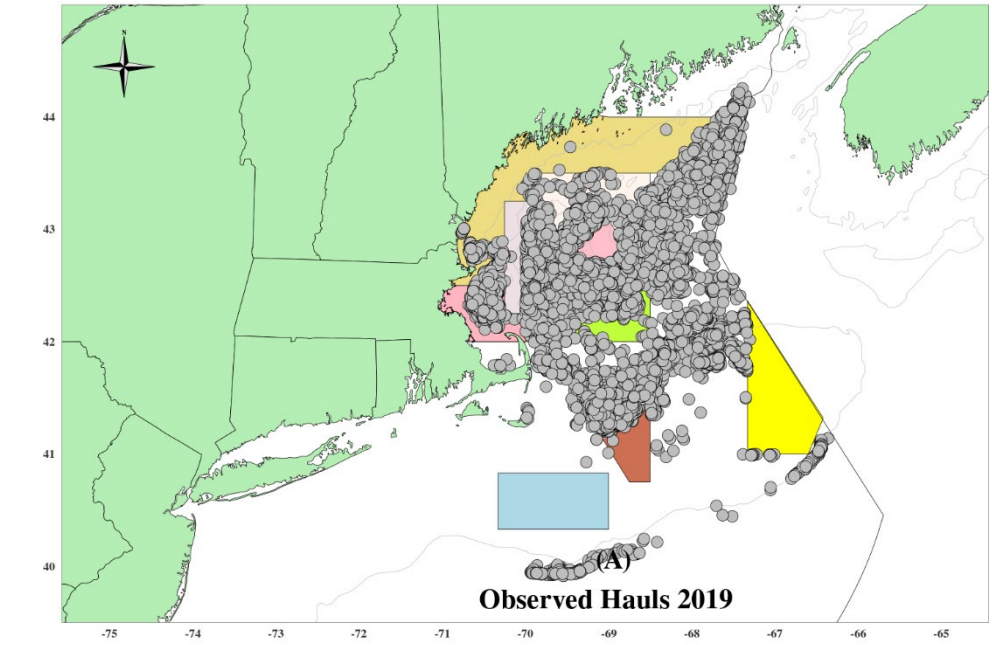


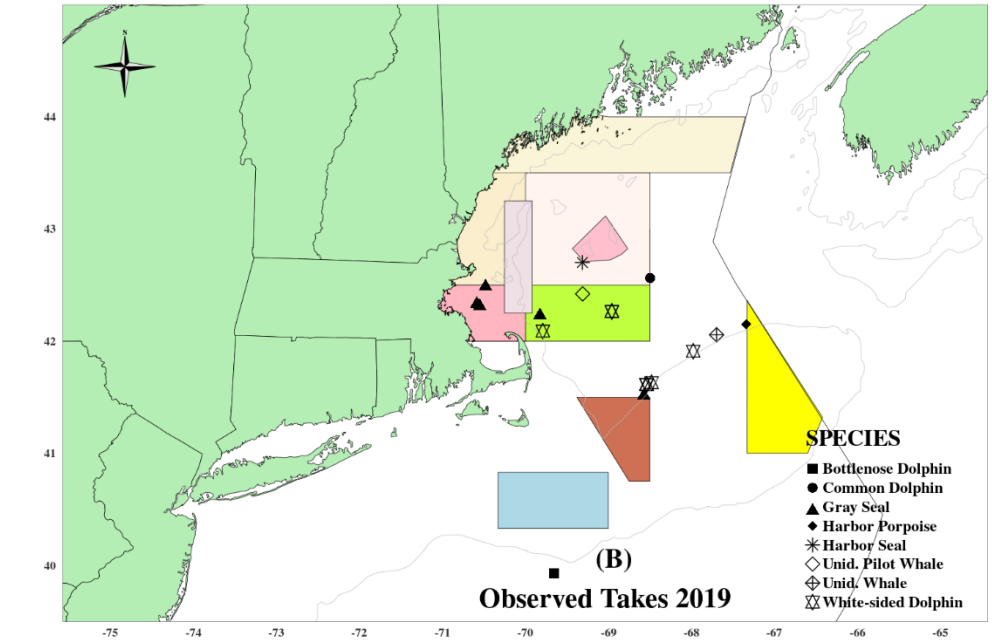


Closed Area 1 Closed Area 2 Western Gulf of Maine Closed Area Nantucket Lightship Closed Area Cashes Ledge Closed Area

Rolling Closure Area 1 Rolling Closure Area 2 Rolling Closure Area 3 Rolling Closure Area 4 Rolling Closure Area 5

Figure 17. 2019 Northeast bottom trawl observed tows (A) and observed takes (B).





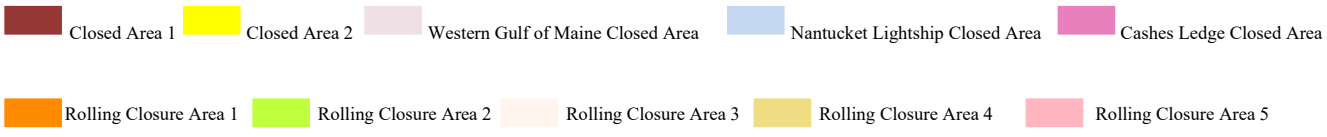


Figure 18. 2020 Northeast bottom trawl observed tows (A) and observed takes (B).

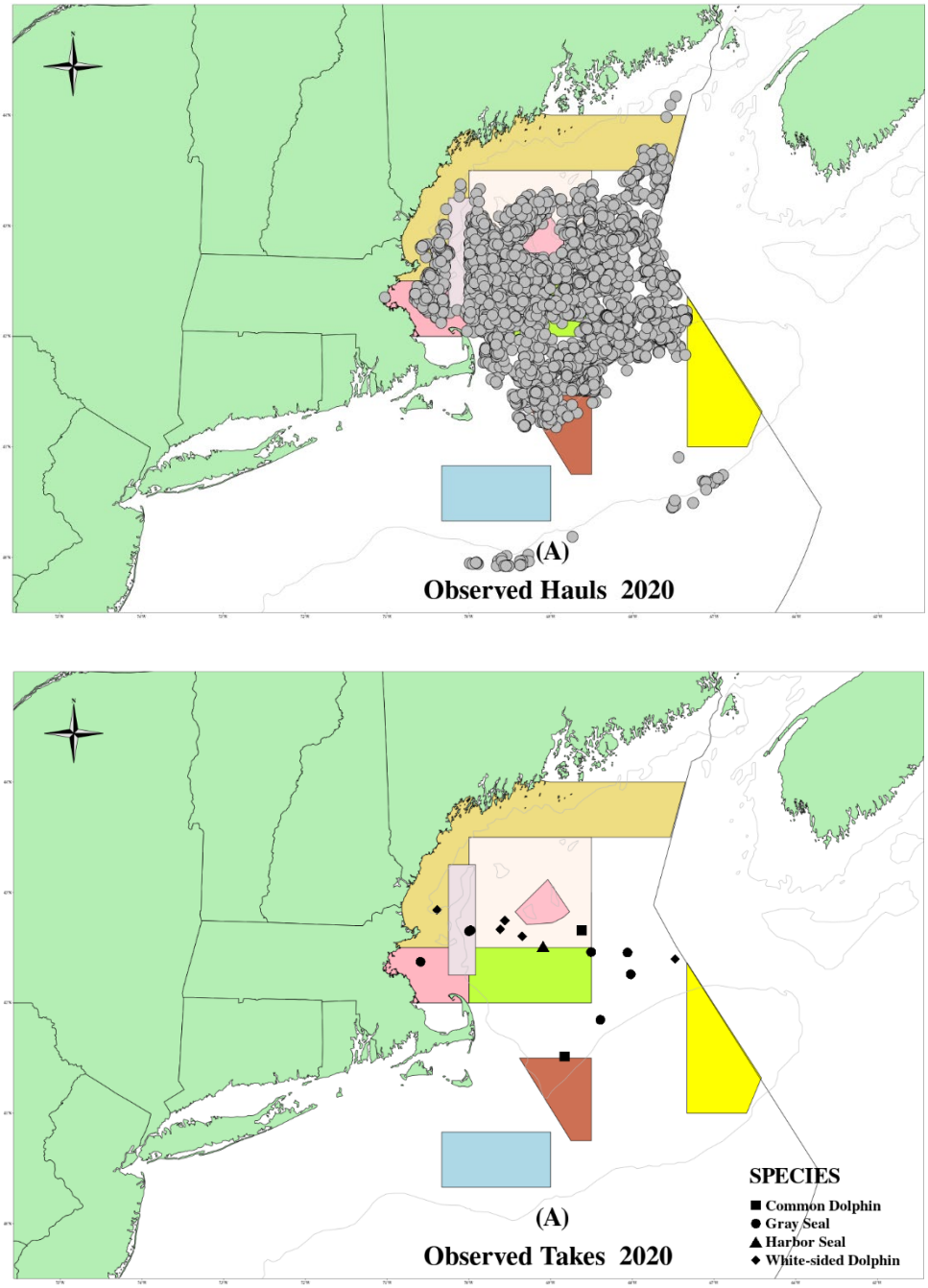


Figure 19. 2021 Northeast bottom trawl observed tows (A) and observed takes (B).

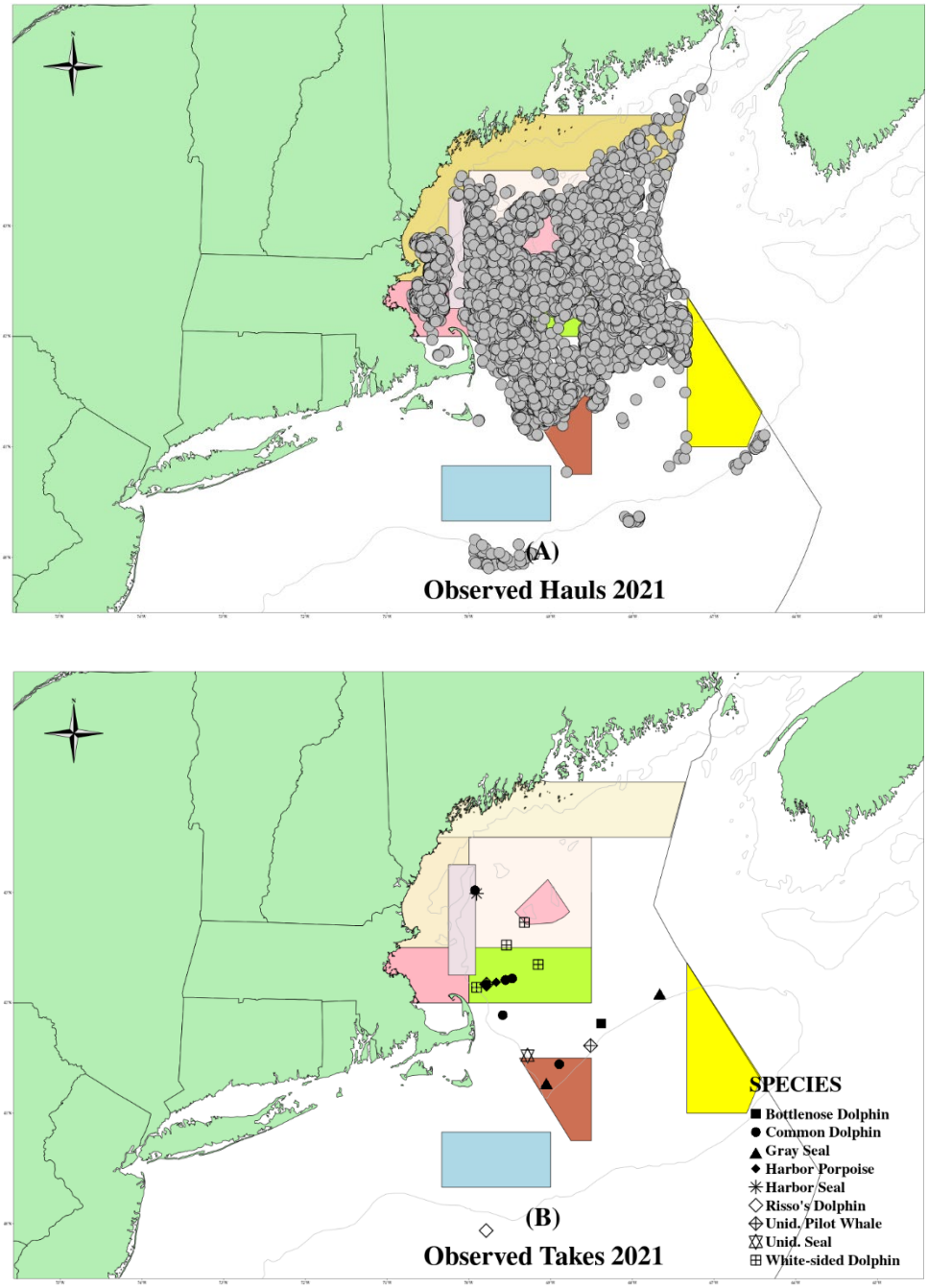
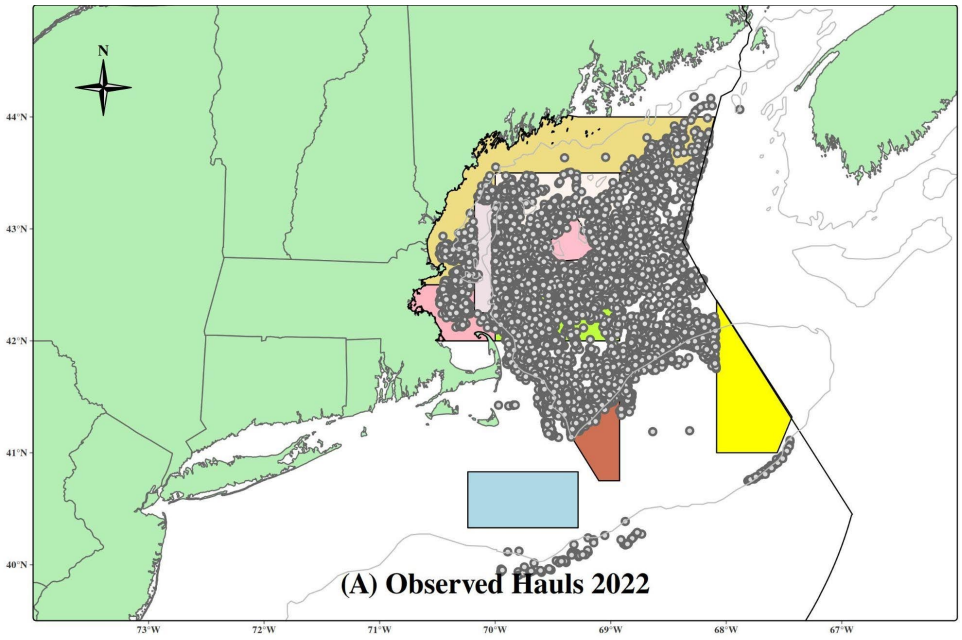
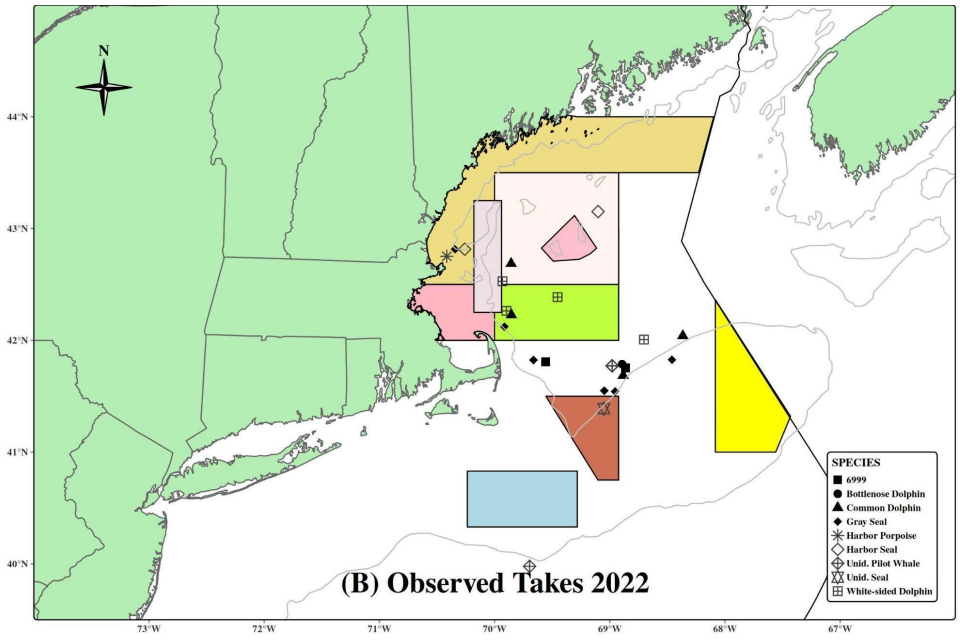


Figure 20. 2022 Northeast bottom trawl observed tows (A) and observed takes (B).





Closed Area 1 Closed Area 2 Western Gulf of Maine Closed Area Nantucket Lightship Closed Area Cashes Ledge Closed Area

Rolling Closure Area 1 Rolling Closure Area 2 Rolling Closure Area 3 Rolling Closure Area 4 Rolling Closure Area 5

Figure 21. 2018 Northeast mid-water trawl observed tows (A) and observed takes (B).

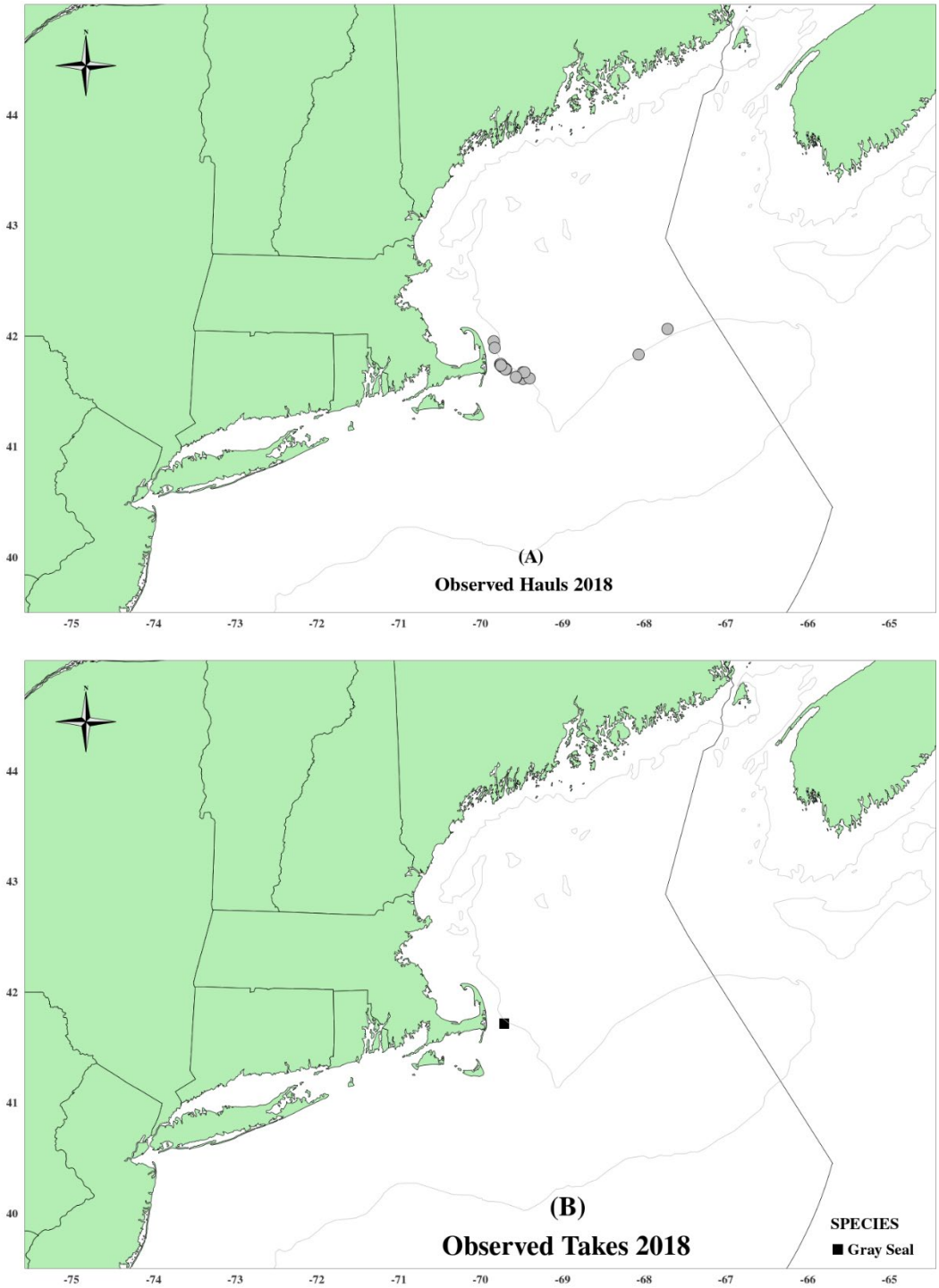


Figure 22. 2019 Northeast mid-water trawl observed tows (A) and observed takes (B).

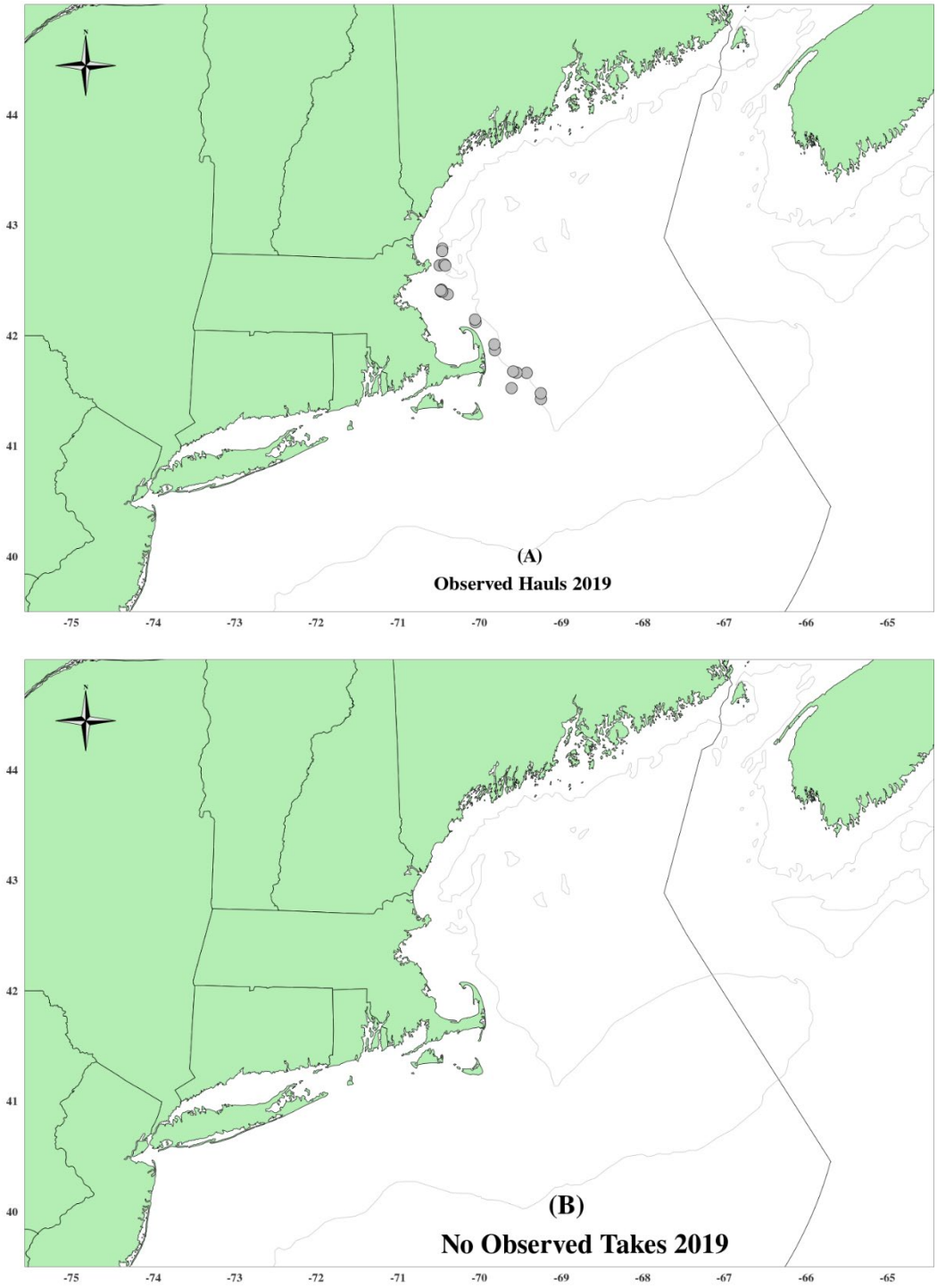
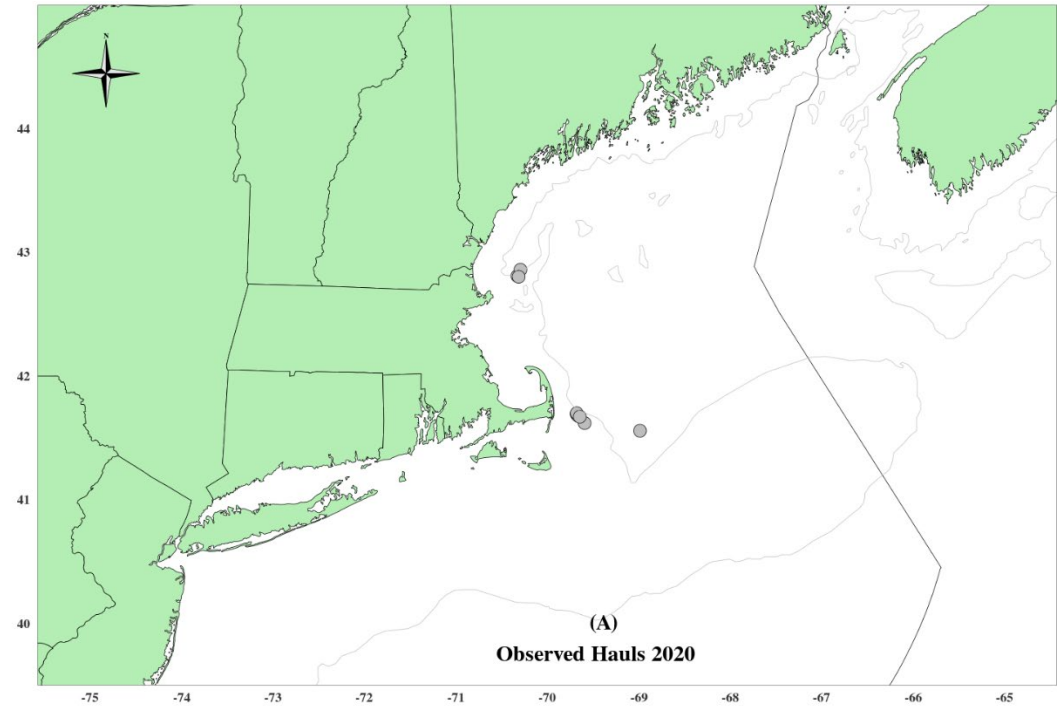


Figure 23. 2020 Northeast mid-water trawl observed tows (A) and observed takes (B).



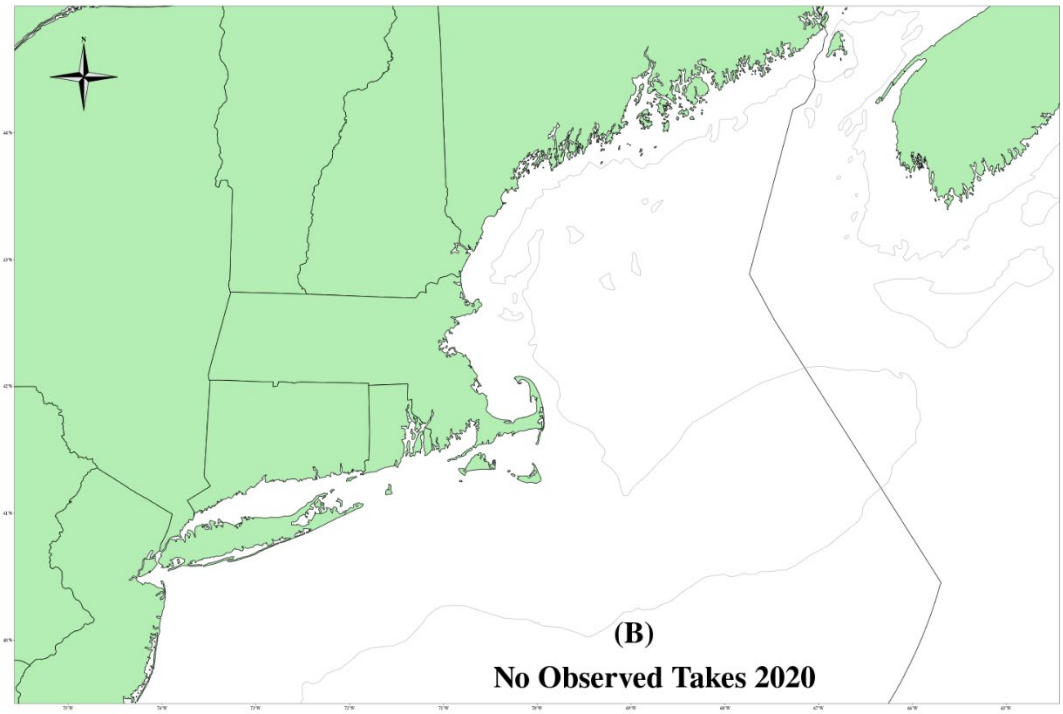
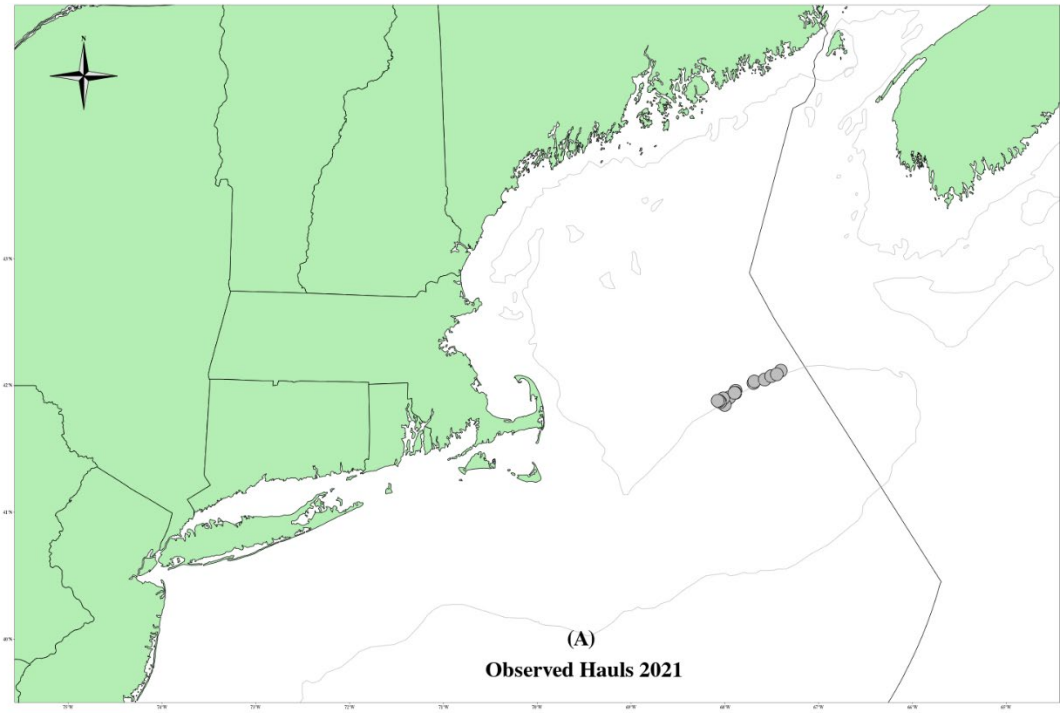


Figure 24. 2021 Northeast mid-water trawl observed tows (A) and observed takes (B).



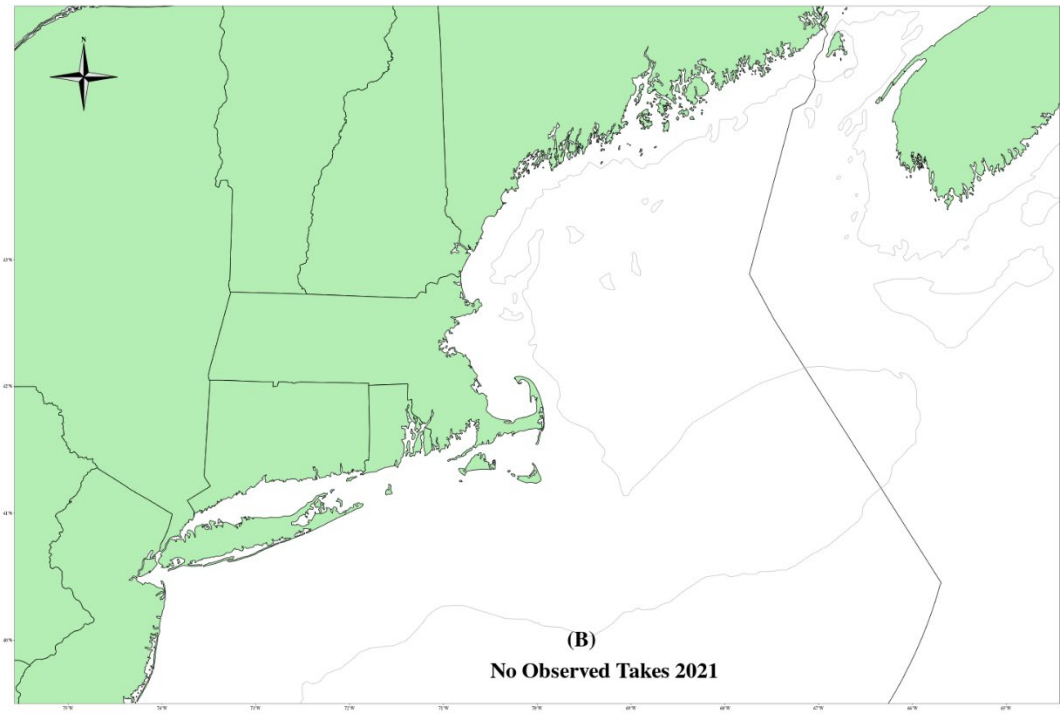


Figure 25. 2022 Northeast mid-water trawl observed tows (A) and observed takes (B).

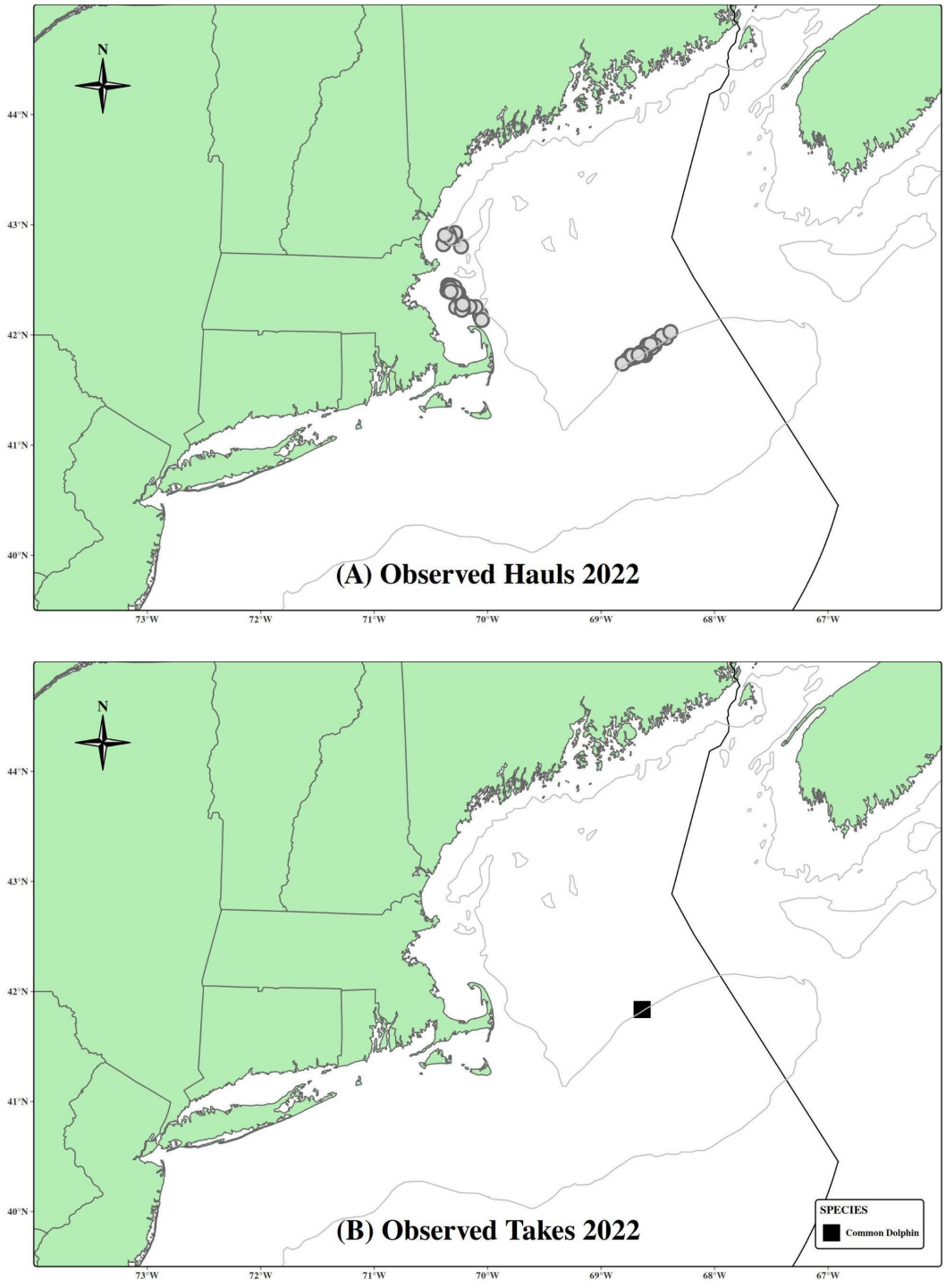


Figure 26. 2018 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

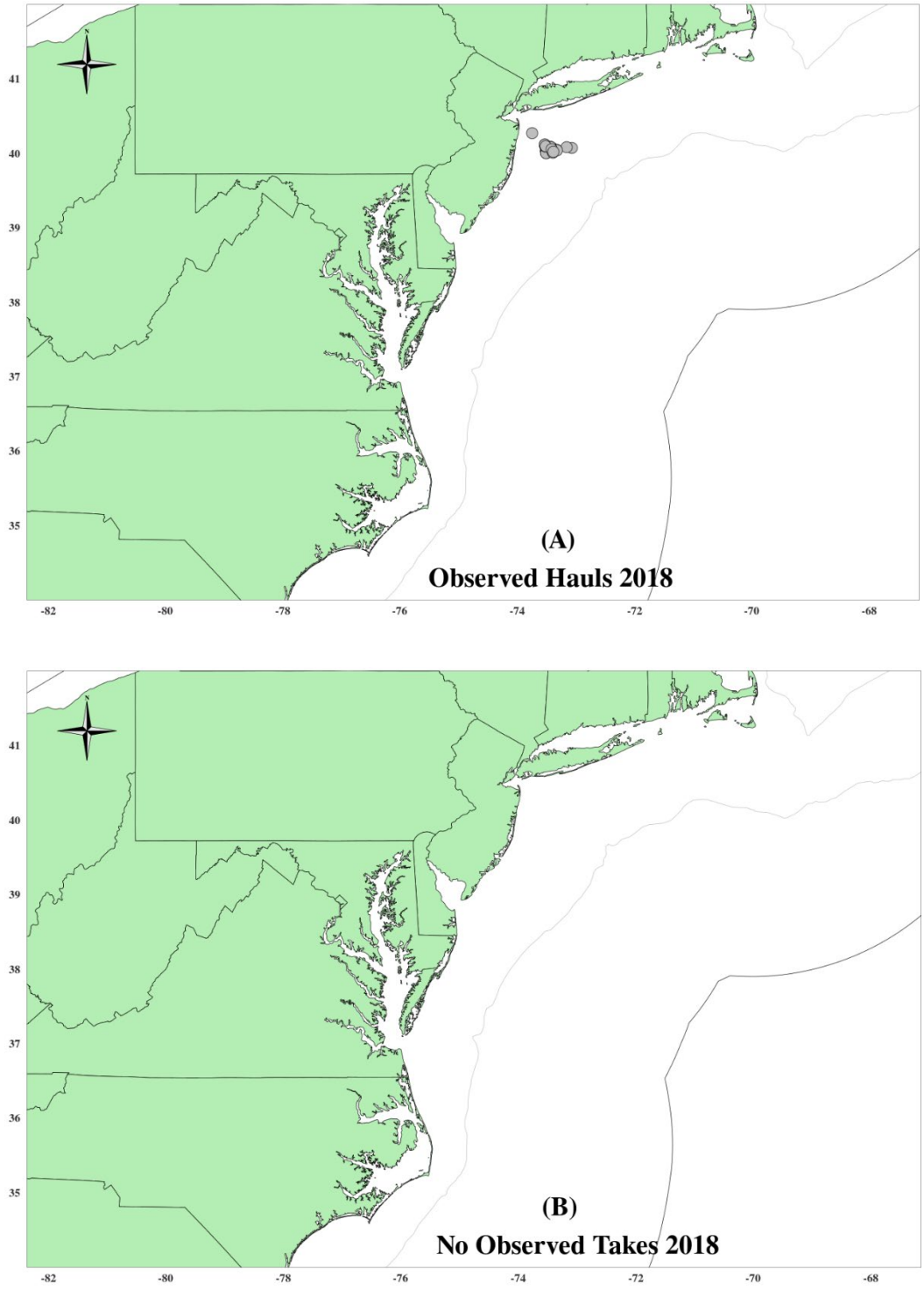


Figure 27. 2019 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

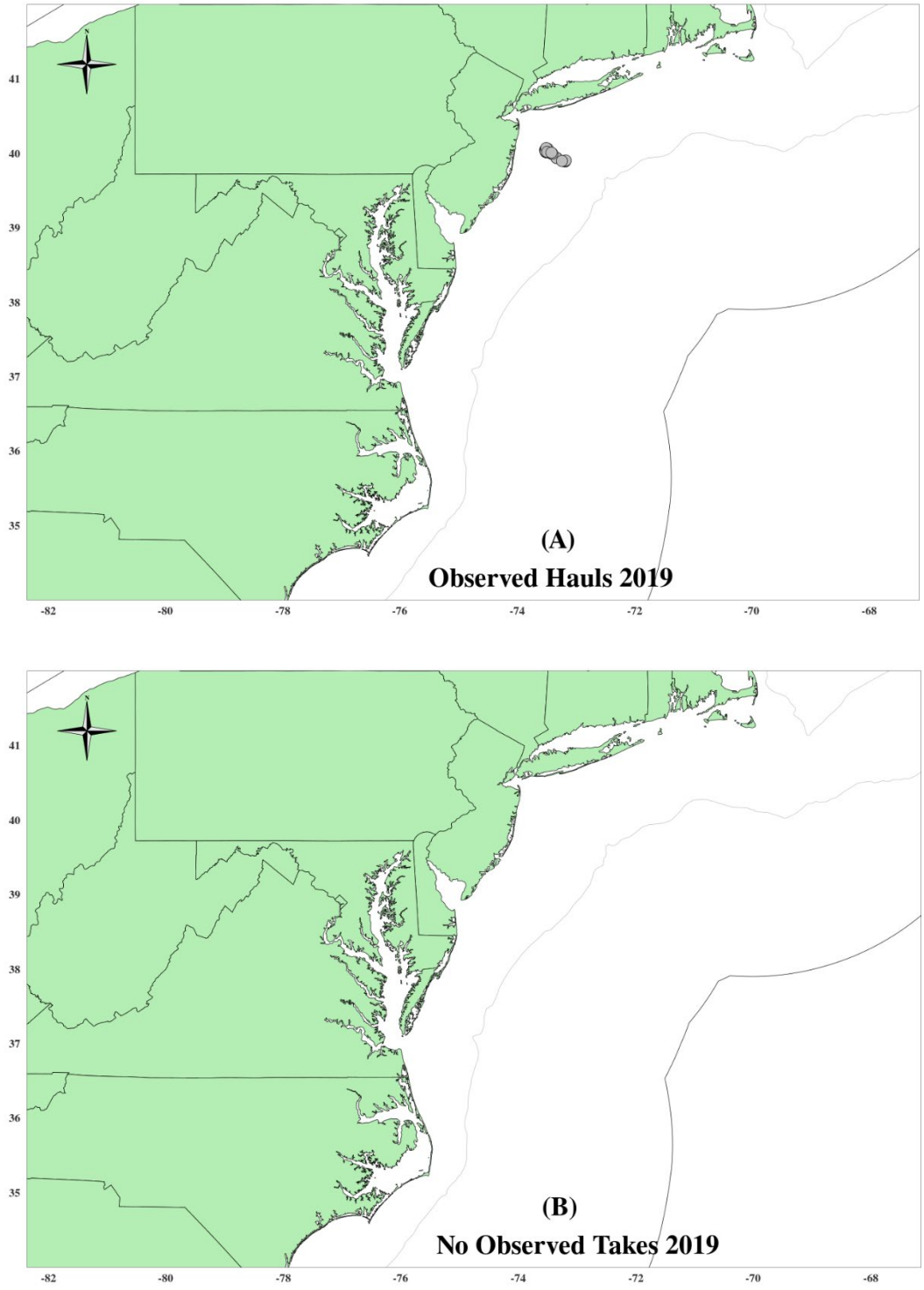
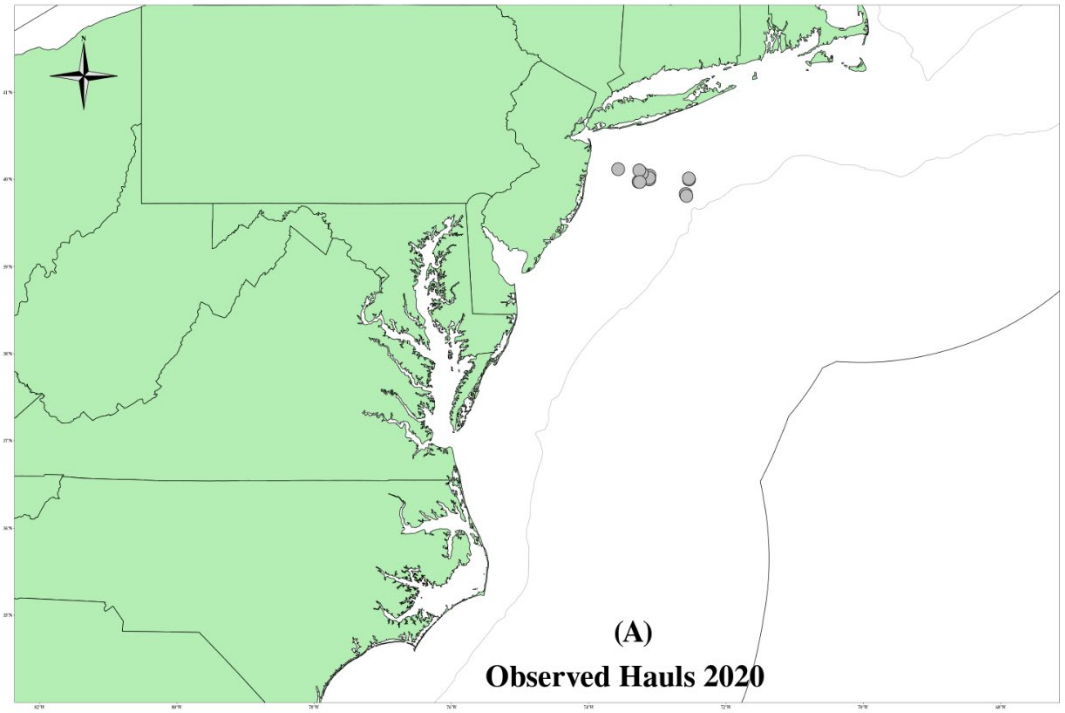


Figure 28. 2020 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).



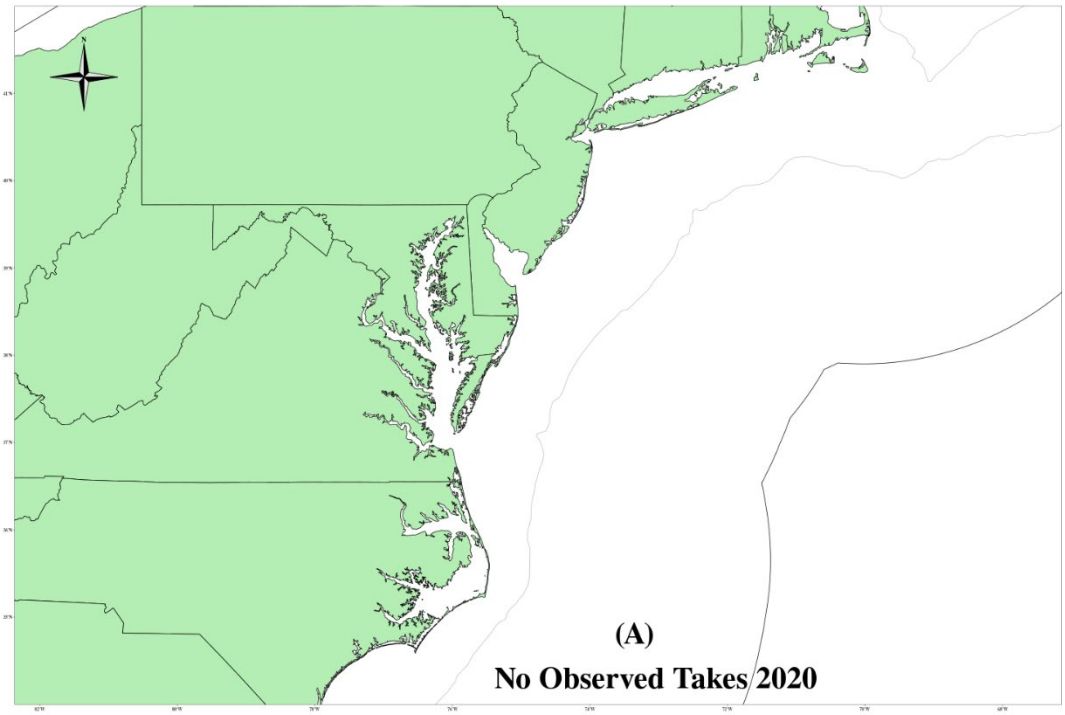
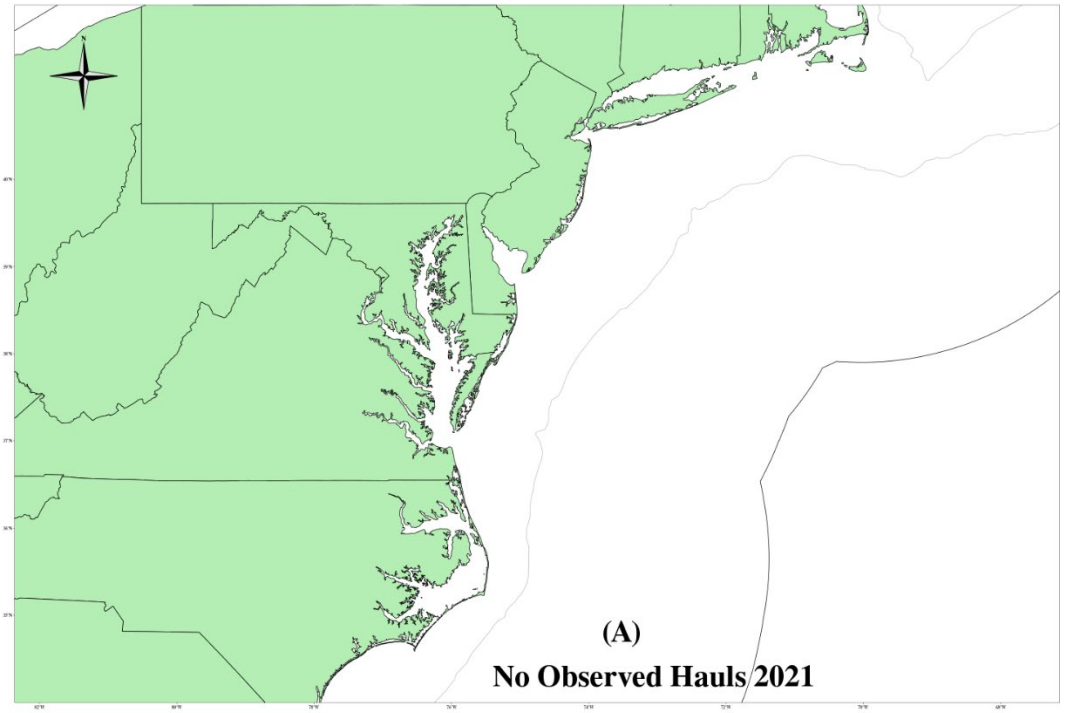


Figure 29. 2021 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).



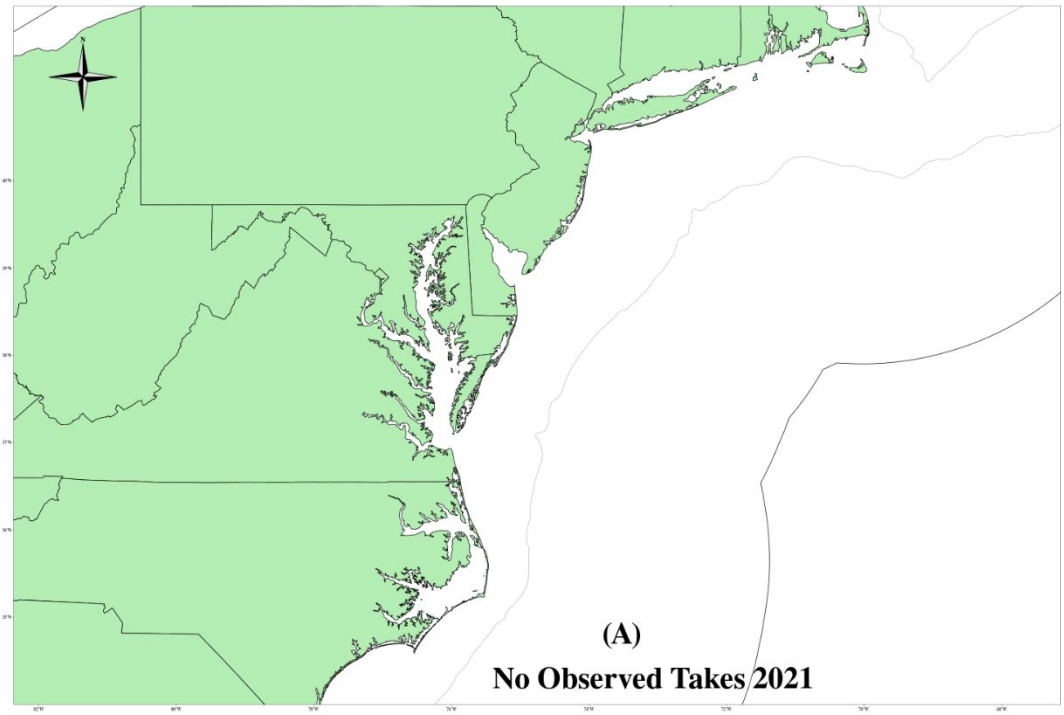
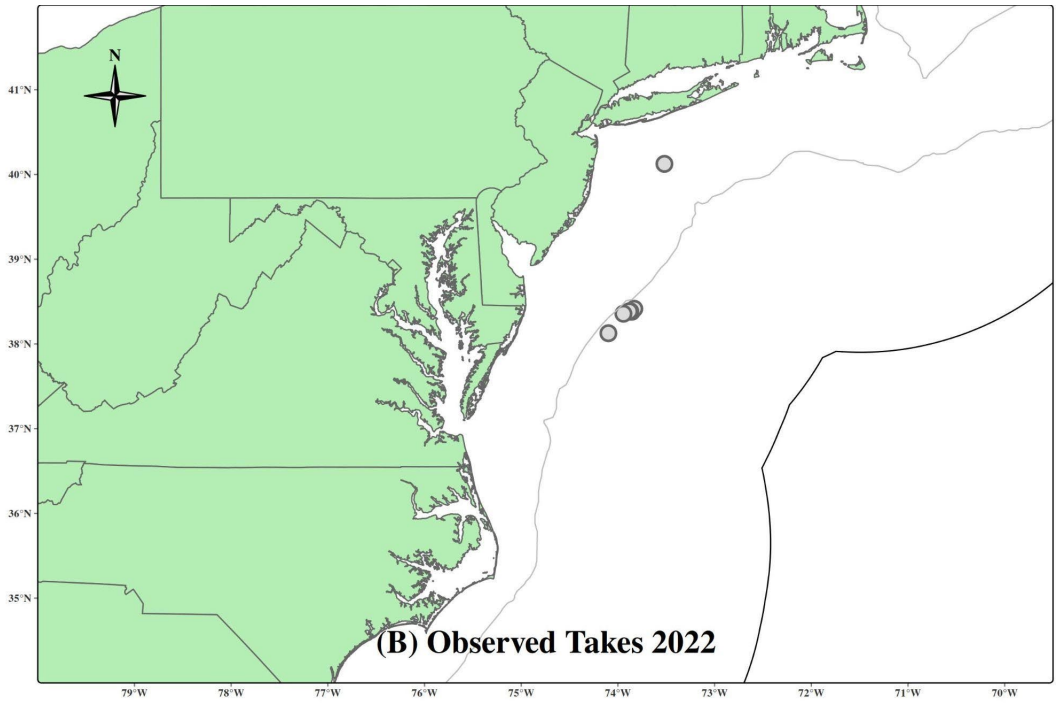


Figure 30. 2022 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).



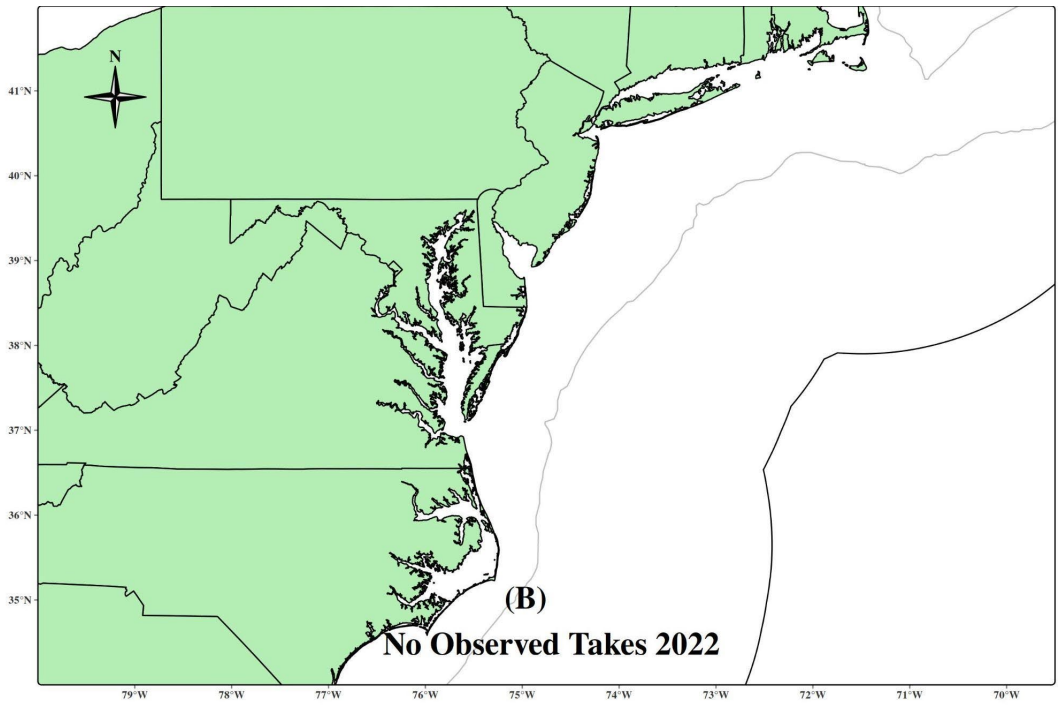


Figure 31. 2018 Herring Purse Seine observed hauls (A) and observed takes (B).

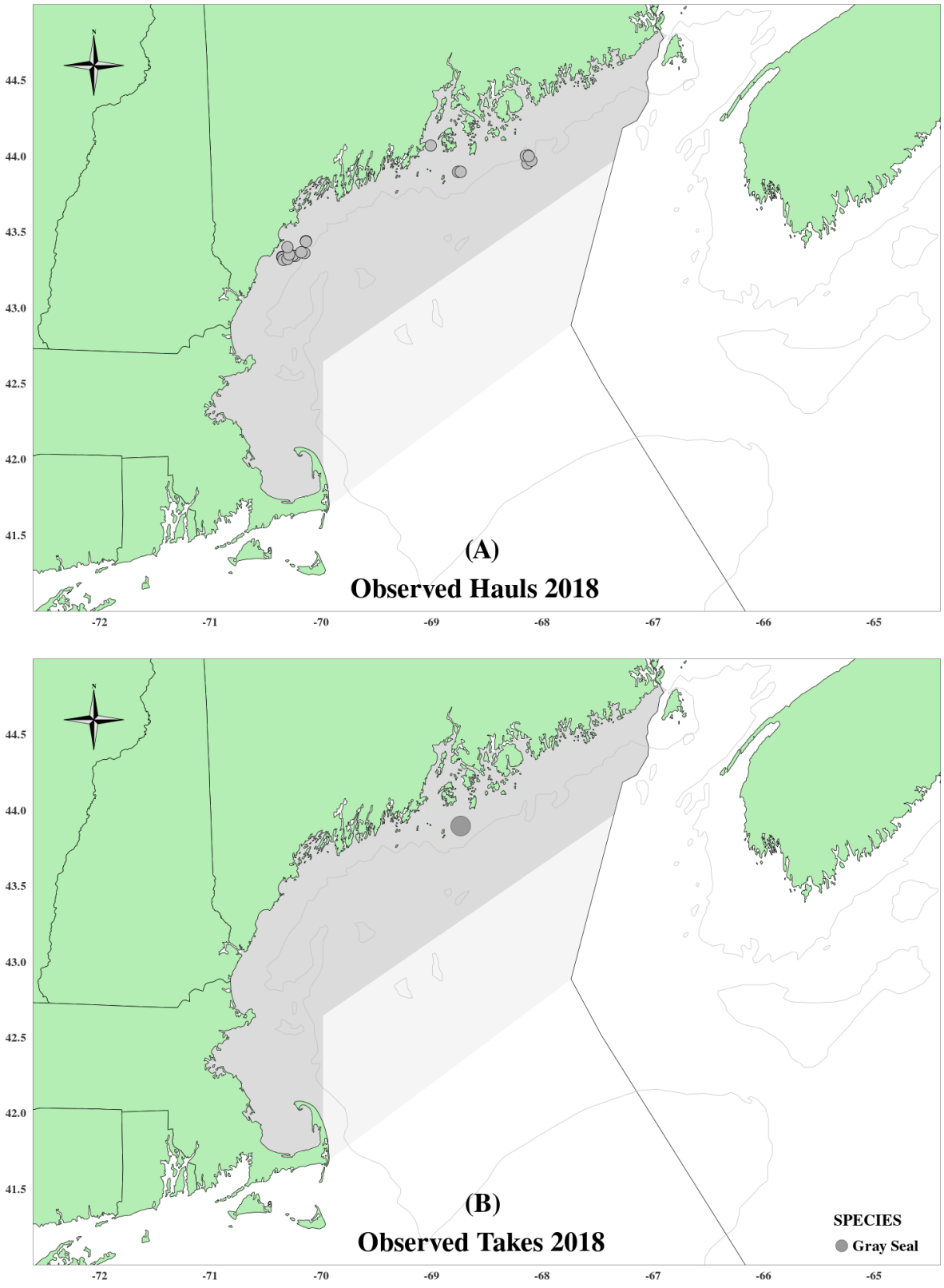


Figure 32. 2019 Herring Purse Seine observed hauls (A) and observed takes (B).

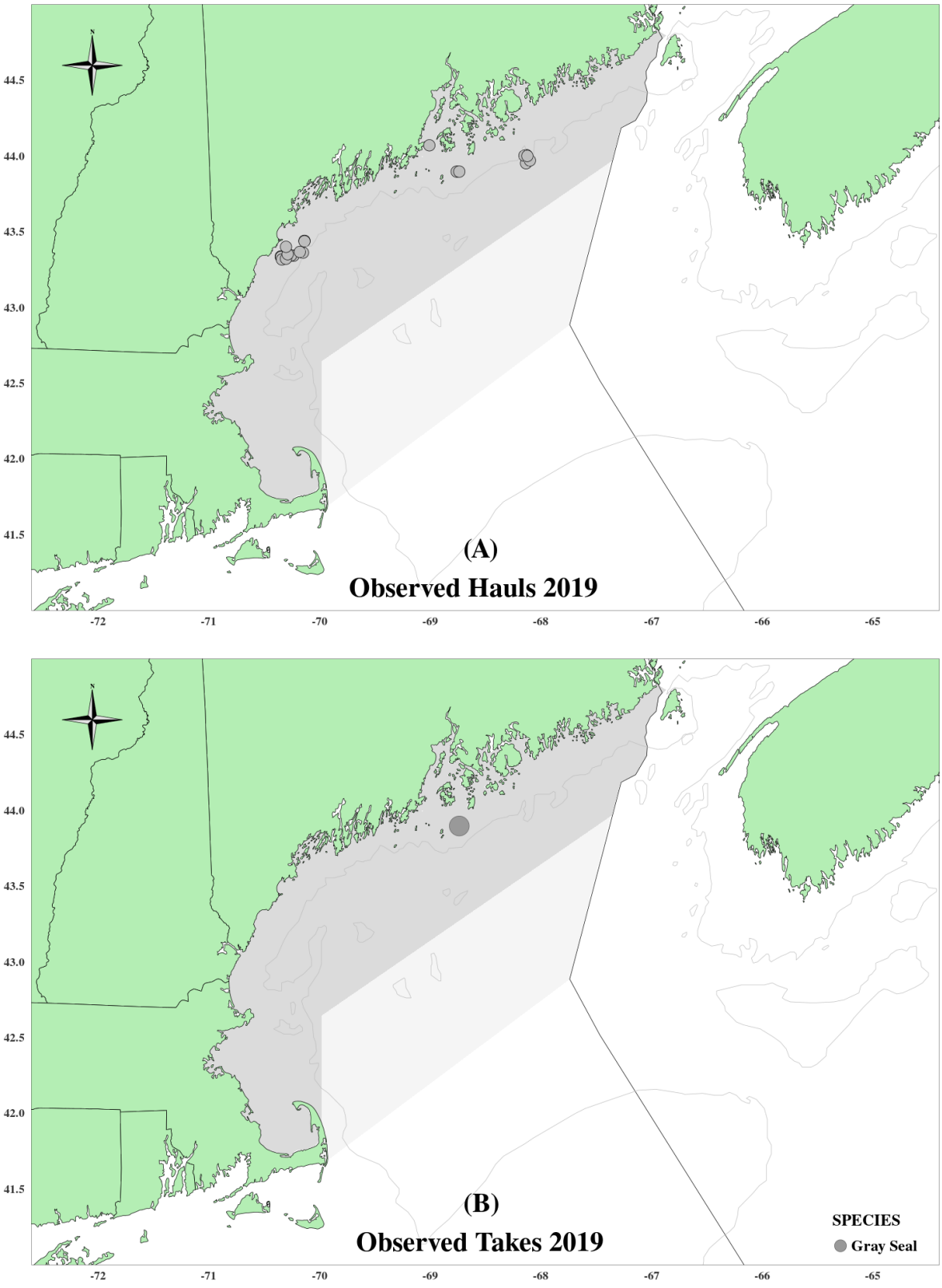


Figure 33. 2020 Herring Purse Seine observed hauls (A) and observed takes (B).

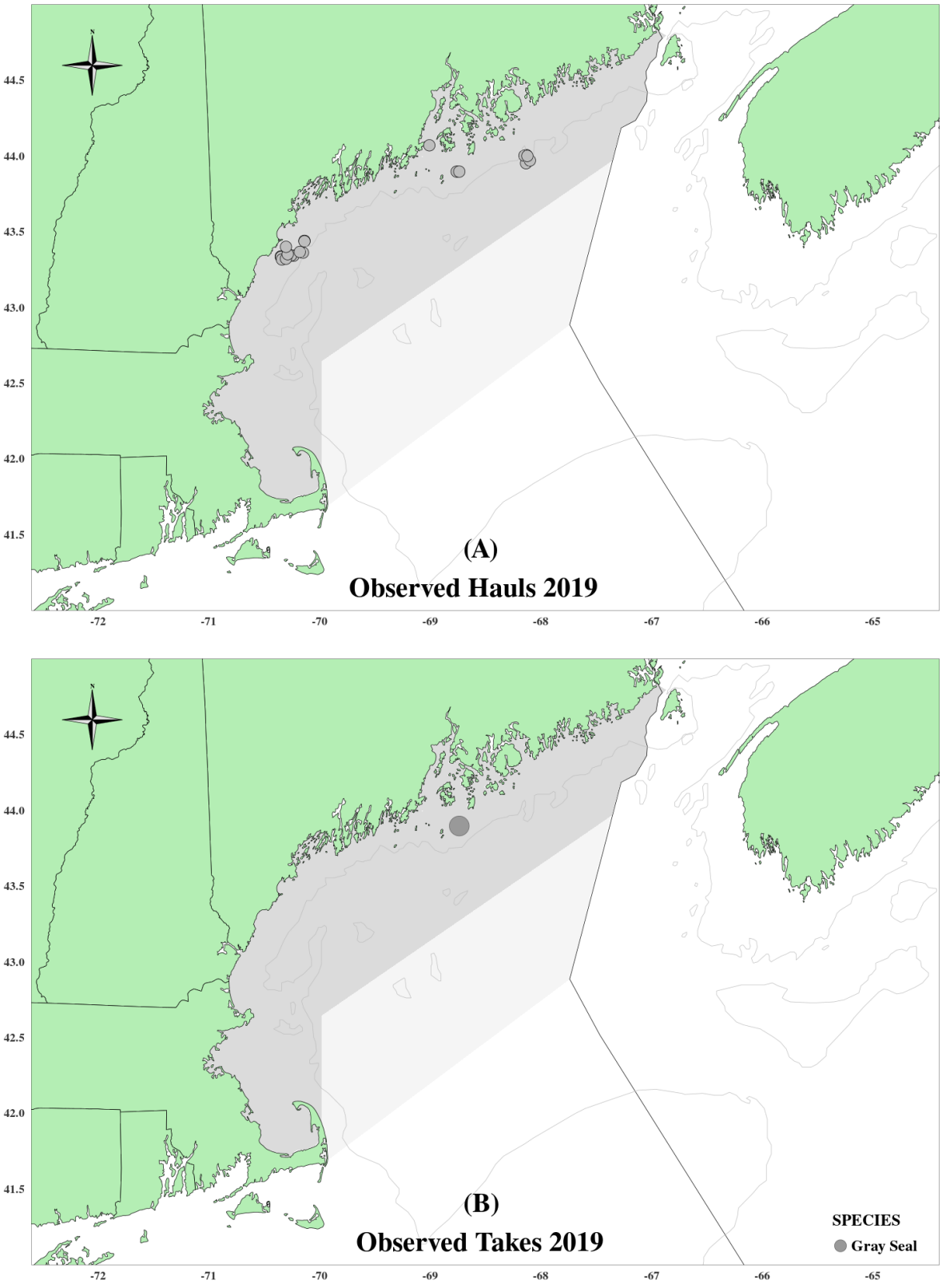


Figure 34. 2021 Herring Purse Seine observed hauls (A) and observed takes (B).

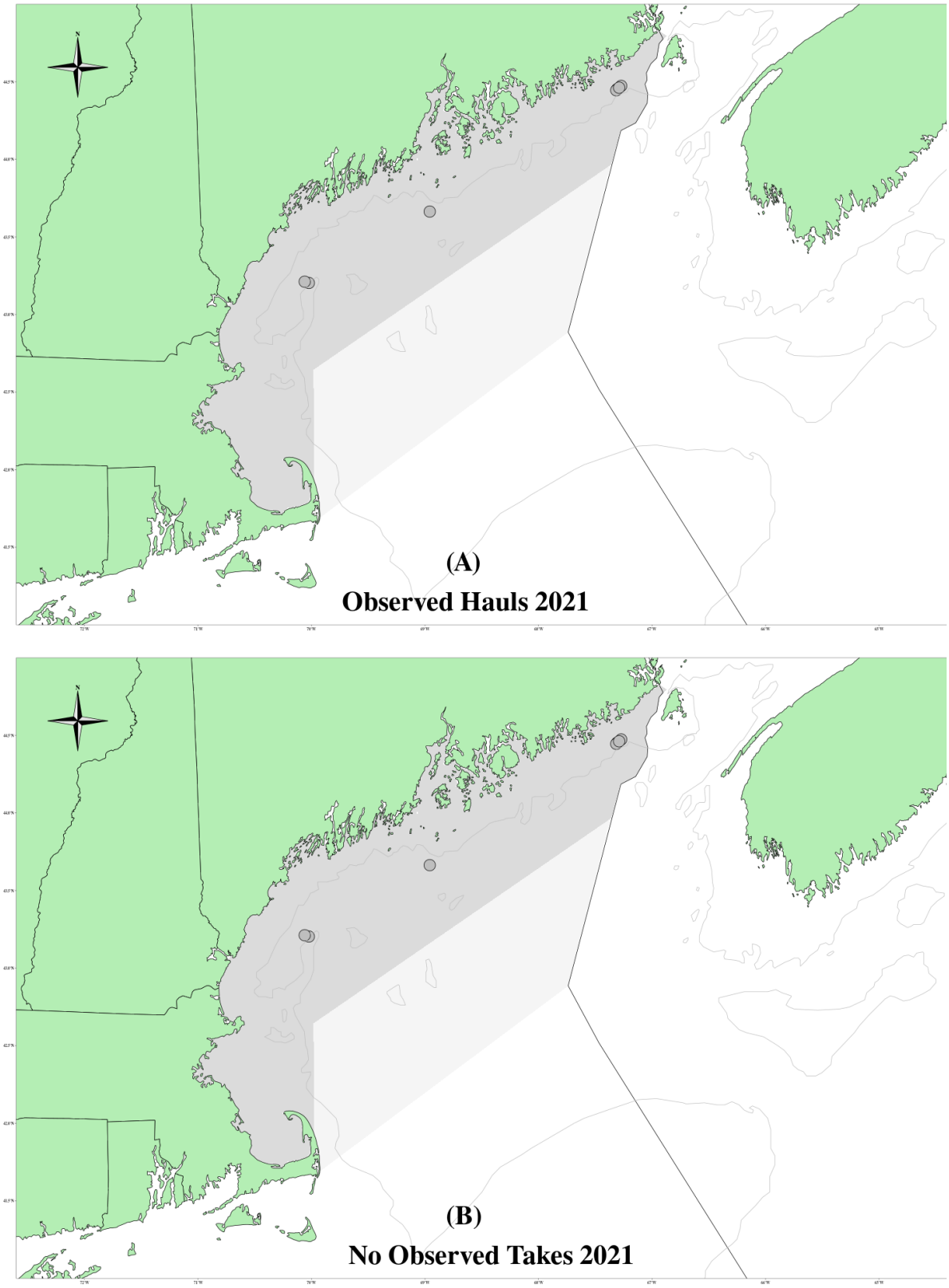
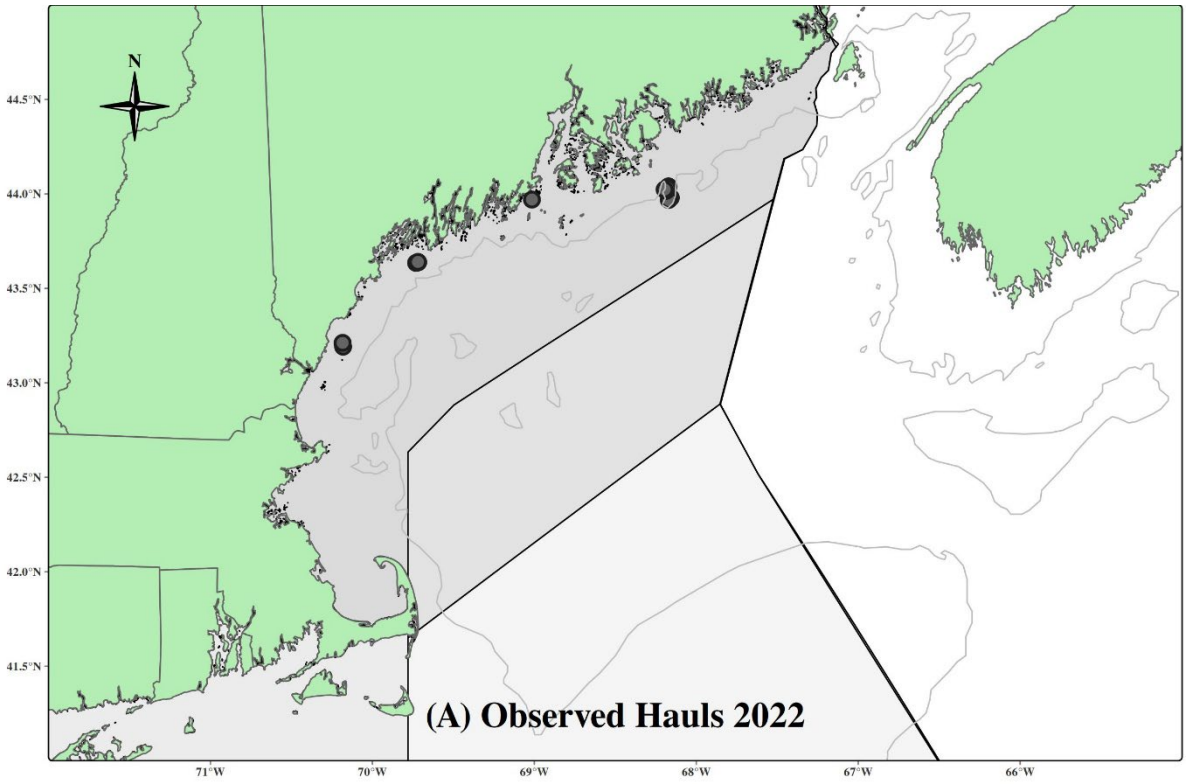


Figure 35. 2022 Herring Purse Seine observed hauls (A) and observed takes (B).



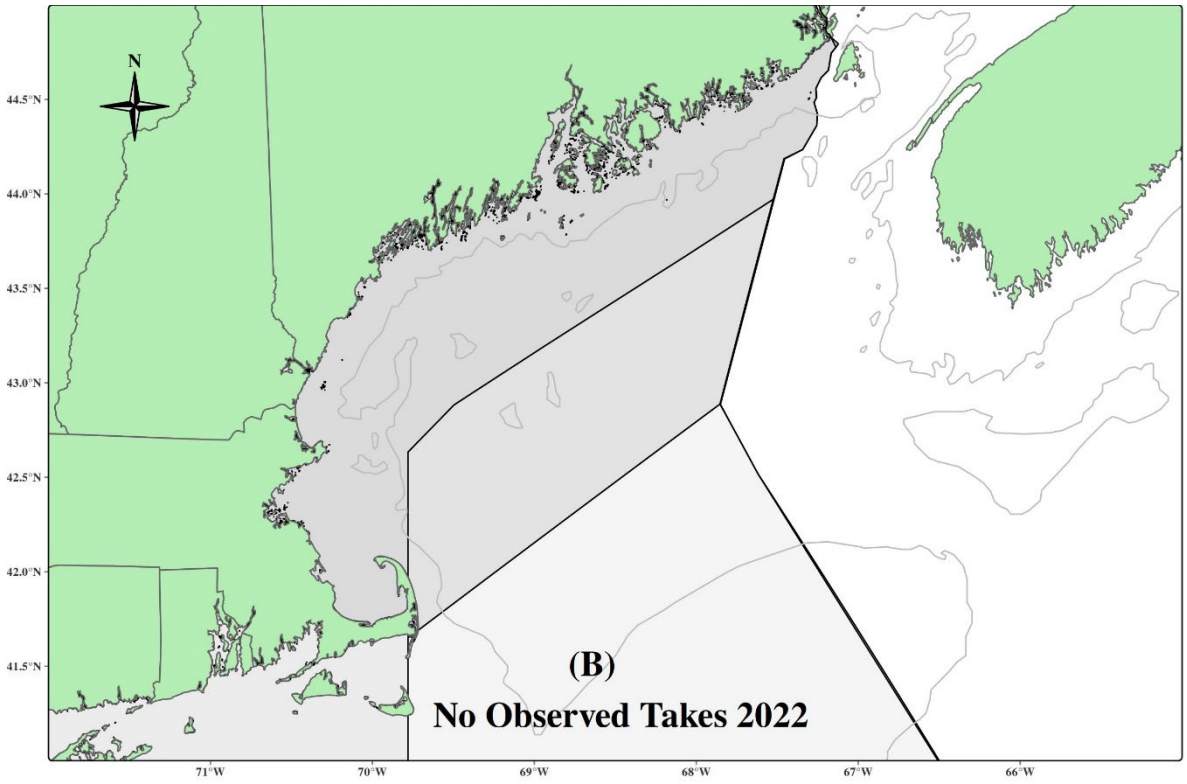


Figure 36. The location of marine mammal interactions and the number of observed sets in 2 degree latitude x 2 degree longitude grid cells in the U.S. Atlantic and Gulf of America Pelagic Longline fishery during 2018. The boundary of the US Exclusive Economic Zone is indicated by a dashed line.

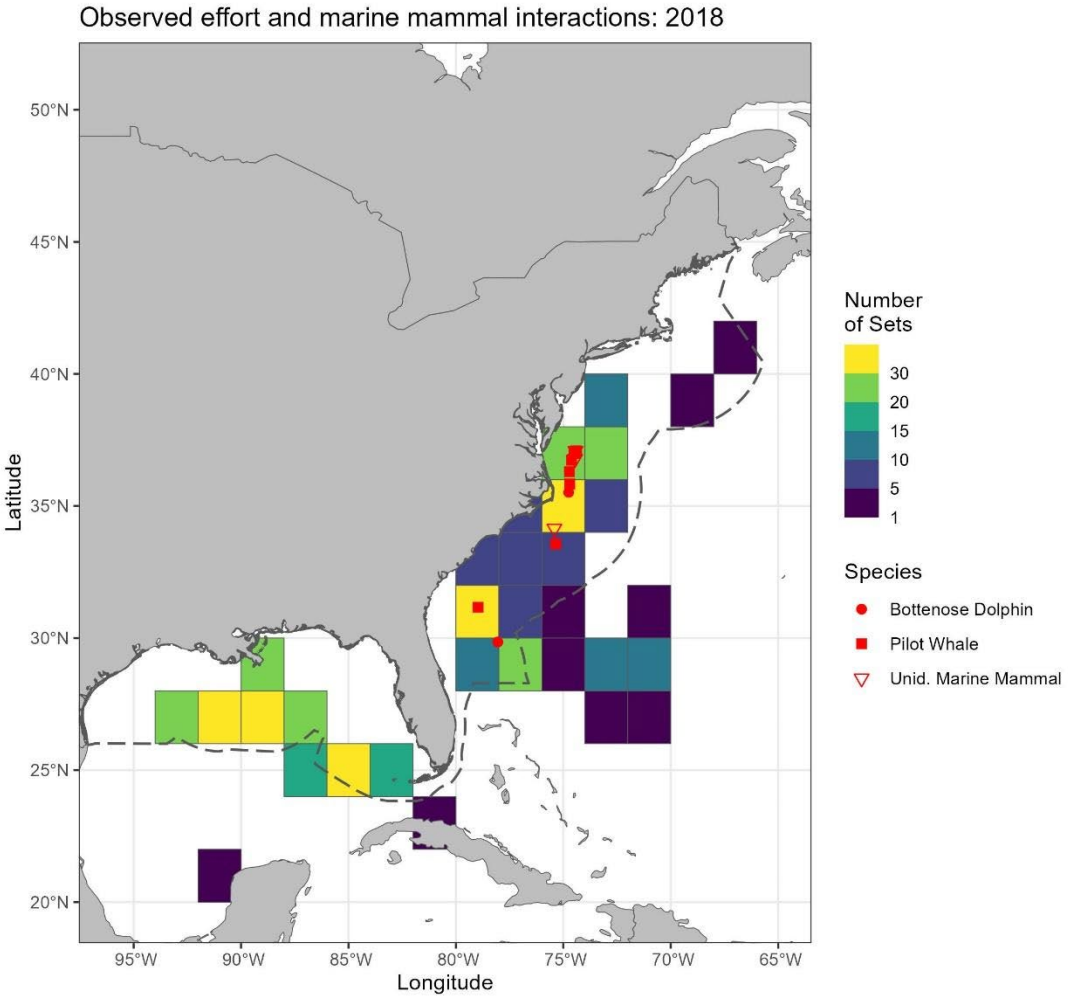


Figure 37. The location of marine mammal interactions and the number of observed sets in 2 degree latitude x 2 degree longitude grid cells in the U.S. Atlantic and Gulf of America Pelagic Longline fishery during 2019. The boundary of the US Exclusive Economic Zone is indicated by a dashed line.

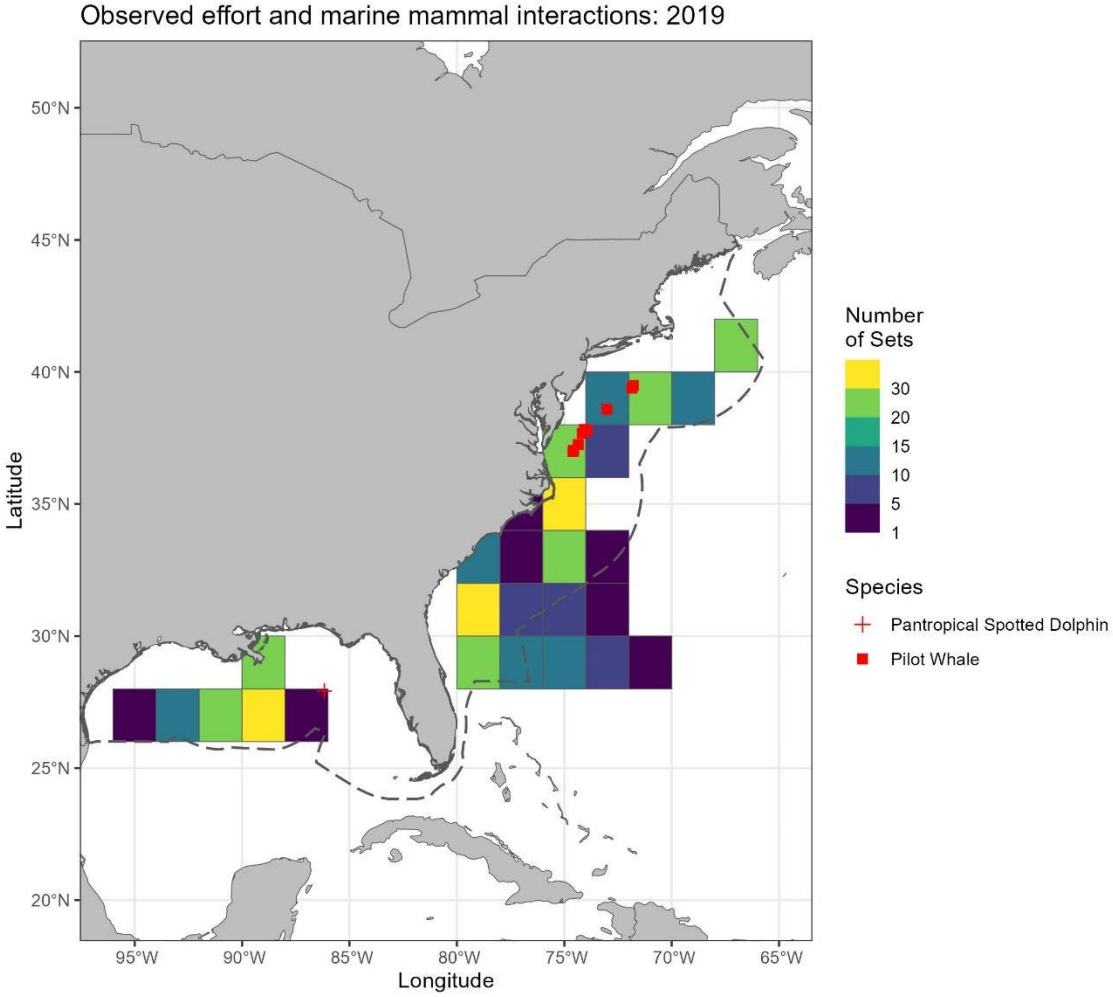


Figure 38. The location of marine mammal interactions and the number of observed sets in 2 degree latitude x 2 degree longitude grid cells in the U.S. Atlantic and Gulf of America Pelagic Longline fishery during 2020. The boundary of the US Exclusive Economic Zone is indicated by a dashed line.

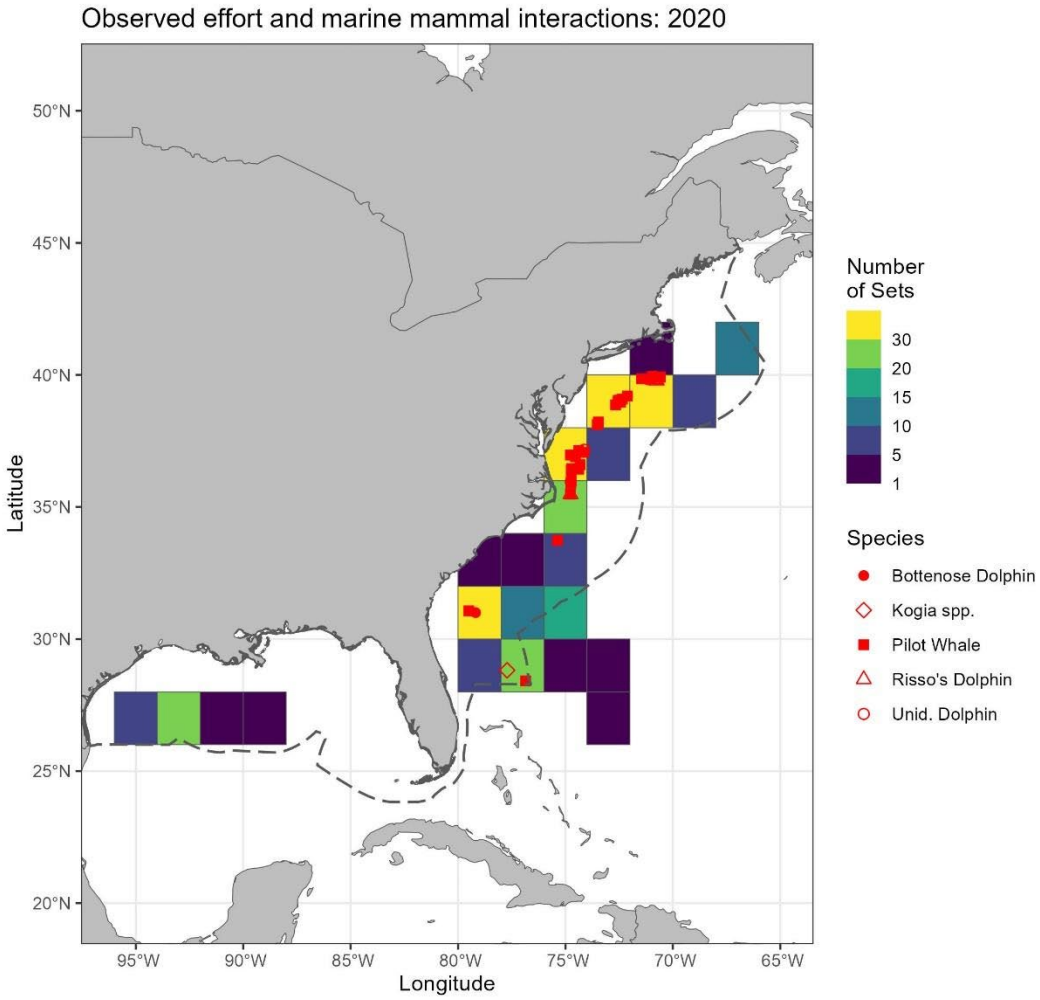


Figure 39. The location of marine mammal interactions and the number of observed sets in 2 degree latitude x 2 degree longitude grid cells in the U.S. Atlantic and Gulf of America Pelagic Longline fishery during 2021. The boundary of the US Exclusive Economic Zone is indicated by a dashed line.

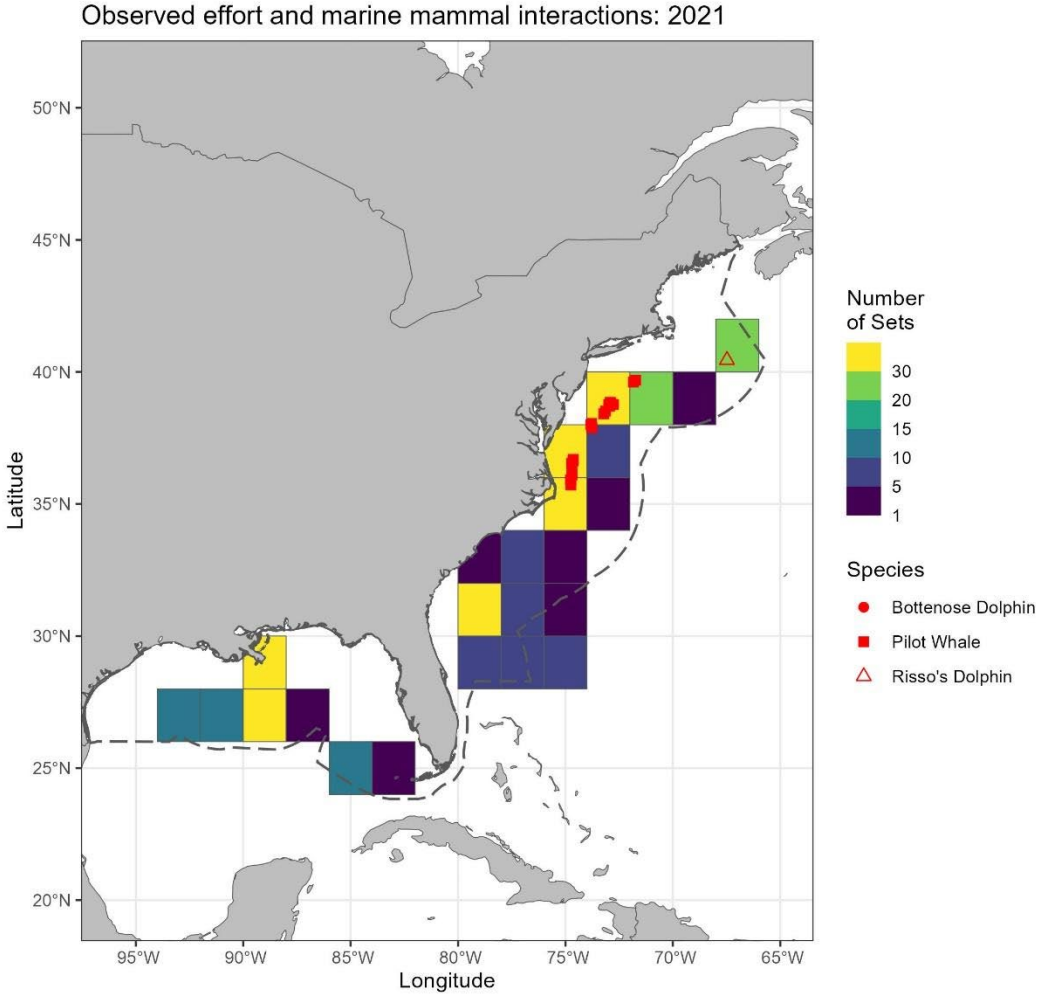
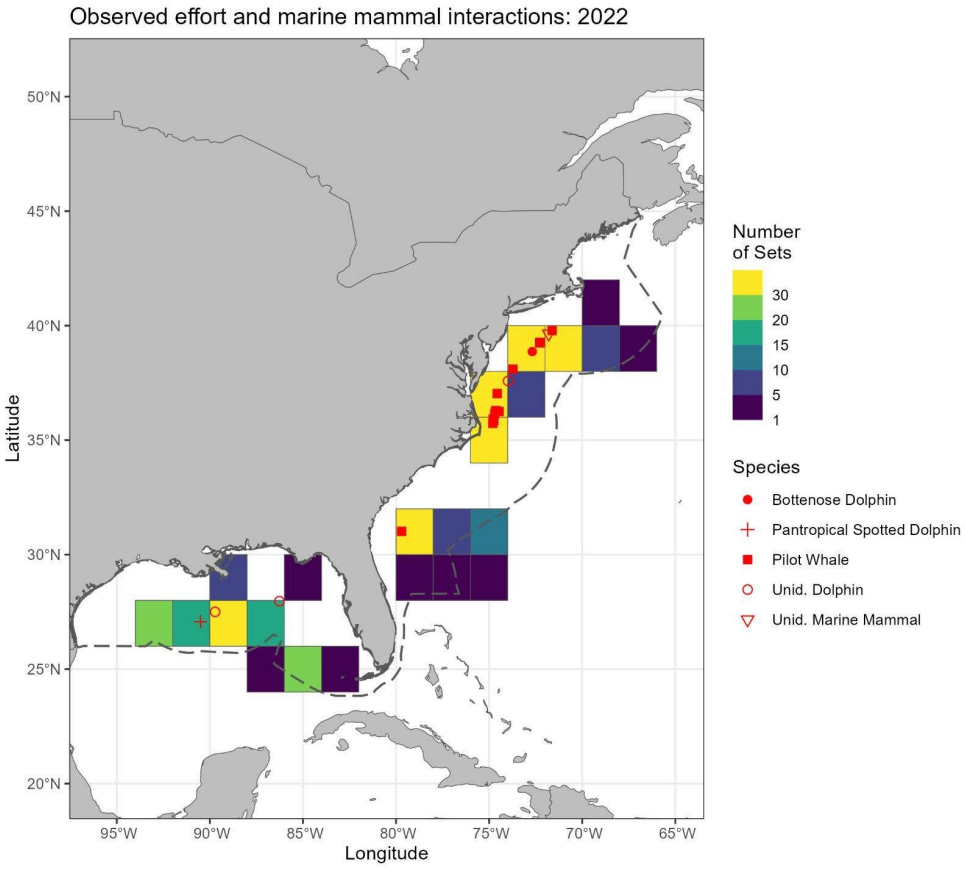


Figure 40. The location of marine mammal interactions and the number of observed sets in 2 degree latitude x 2 degree longitude grid cells in the U.S. Atlantic and Gulf of America Pelagic Longline fishery during 2022. The boundary of the US Exclusive Economic Zone is indicated by a dashed line.



Appendix IV: Table A. Surveys.

Survey Number	Year(s)	Time of Year	Platform	Track Line Length (km)	Area	Agency/ Program	Analysis	Corrected for g(0)	Reference(s)
1	1982	year-round	Plane	211,585	Cape Hatteras, NC to Nova Scotia, (continental shelf & shelf edge waters)	CETAP	Line transect analyses of distance data	N	CETAP 1982
2	1990	Aug	Ship (Chapman)	2,067	Cape Hatteras, NC to Southern New England (north wall of Gulf Stream)	NEC	One team data analyzed by DISTANCE	N	NMFS 1990
3	1991	Jul–Aug	Ship (Abel-J)	1,962	Gulf of Maine, lower Bay of Fundy, southern Scotian Shelf	NEC	Two independent team data analyzed with modified direct duplicate method	Y	Palka 1995
4	1991	Aug	Boat (Sneak Attack)	640	Inshore bays of Maine	NEC	One team data analyzed by DISTANCE	Y	Palka 1995
5	1991	Aug–Sep	Plane 1 (AT-11)	9,663	Cape Hatteras, NC to Nova Scotia (continental shelf & shelf edge waters)	NEC/SEC	One team data analyzed by DISTANCE	N	NMFS 1991
6	1991	Aug–Sep	Plane 2 (Twin Otter)		Cape Hatteras, NC to Nova Scotia (continental shelf & shelf edge waters)	NEC/SEC	One team data analyzed by DISTANCE	N	NMFS 1991
7	1991	Jun–Jul	Ship (Chapman)	4,032	Cape Hatteras to Georges Bank, (between 200 & 2,000m isobaths)	NEC	One team data analyzed by DISTANCE	N	Waring *et al.* 1992; Waring 1998
8	1992	Jul–Sep	Ship (Abel-J)	3,710	N. Gulf of Maine & lower Bay of Fundy	NEC	Two independent team data analyzed with modified direct duplicate method	Y	Smith *et al.* 1993
9	1993	Jun–Jul	Ship (Delaware II)	1,874	S. edge of Georges Bank, across the Northeast Channel, to the SE edge of the Scotian Shelf	NEC	One team data analyzed by DISTANCE		NMFS 1993
10	1994	Aug–Sep	Ship (Relentless)	534	Georges Bank (shelf edge & slope waters)	NEC	One team data analyzed by DISTANCE	N	NMFS 1994
11	1995	Aug–Sep	Plane (Skymaster)	8,427	Gulf of St. Lawrence	DFO	One team data analyzed using Quenouille's Jackknife Bias Reduction Method that modeled the left truncated sighting curve	N	Kingsley and Reeves 1998
12	1995	Jul–Sep	2 Ships (Abel-J & Pelican) & Plane (Twin Otter)	32,600	Virginia to the mouth of the Gulf of St. Lawrence	NEC	Ship: Two independent team data analyzed with modified direct duplicate method. Plane: One team data analyzed by DISTANCE.	Y/N	Palka 1996

Survey Number	Year(s)	Time of Year	Platform	Track Line Length (km)	Area	Agency/ Program	Analysis	Corrected for g(0)	Reference(s)
13	1996	Jul–Aug	Plane	3,993	Northern Gulf of St. Lawrence	DFO	Quenouille's Jackknife Bias Reduction Method on line-transect methods that modeled the left truncated sighting curve	N	Kingsley and Reeves 1998
14	1998	Jul–Aug	Ship	4,163	South of Maryland	SEC	One team data analyzed by DISTANCE	N	Mullin and Fulling 2003
15	1998	Aug–Sep	Plane		Gulf of St. Lawrence	DFO			Kingsley and Reeves 1998
16	1998	Jul–Sep	Ship (Abel-J) & Plane (Twin Otter)	15,900	North of Maryland	NEC	Ship: Two independent team data analyzed with the modified direct duplicate or Palka & Hammond analysis methods, depending on the presence of responsive movement. Plane: One team data analyzed by DISTANCE.	Y	
17	1999	Jul–Aug	Ship (Abel-J) & Plane (Twin Otter)	6,123	South of Cape Cod to mouth of Gulf of St. Lawrence	NEC	Ship: Two independent team data analyzed with modified direct duplicate or Palka & Hammond analysis methods, depending on the presence of responsive movement. Plane: Circle-back data pooled with aerial data collected in 1999, 2002, 2004, 2006, 2007, and 2008 to calculate pooled g(0)'s and year-species specific abundance estimates for all years except 2008.	Y	
18	2002	Jul–Aug	Plane (Twin Otter)	7,465	Georges Bank to Maine	NEC	Same as for plane in survey 17	Y	Palka 2006
19	2002	Feb–Apr	Ship (Gunter)	4,592	SE US continental shelf - Delaware to Florida	SEC	One team data analyzed by DISTANCE	N	
20	2002	Jun–Jul	Plane	6,734	Florida to New Jersey	SEC	Two independent team data analyzed with modified direct duplicate method	Y	
21	2004	Jun–Aug	Ship (Gunter)	5,659	Florida to Maryland	SEC	Two independent team data analyzed with modified direct duplicate method	Y	Garrison *et al.* 2010
22	2004	Jun–Aug	Ship (Endeavor) & plane (Twin Otter)	10,761	Maryland to Bay of Fundy	NEC	Same methods used in survey 17	Y	Palka 2006
23	2006	Aug	Plane (Twin Otter)	10,676	Georges Bank to Bay of Fundy	NEC	Same as for plane in survey 17	Y	Palka 2005
24	2007	Aug	Ship (Bigelow) & Plane (Twin Otter)	8,195	Georges Bank to Bay of Fundy	NEC	Ship: Tracker data analyzed by DISTANCE. Plane: Same as for plane in survey 17	Y	Palka 2005
25	2007	Jul–Aug	Plane	46,804	Nova Scotia to Newfoundland	DFO	Uncorrected counts	N	Lawson and Gosselin 2009
26	2008	Aug	Plane (Twin Otter)	6,267	New York to Maine	NEC	Same as for plane in survey 17	Y	Palka 2005
27	2001	May–Jun	Plane		Maine Coast	NEC, UM	Corrected counts	N	Gilbert *et al.* 2005
28	1999	Mar	Plane		Cape Cod	NEC	Uncorrected counts	N	Barlas 1999

Survey Number	Year(s)	Time of Year	Platform	Track Line Length (km)	Area	Agency/ Program	Analysis	Corrected for g(0)	Reference(s)
29	1983–1986	1983 (Fall), 1984 (Winter, Spring, Summer), 1985 (Summer, Fall), 1986 (Winter)	Plane (Beechcraft D-18S, modified with a bubblenose)	103,490	Northern Gulf of America bays & sounds (coastal waters from shoreline to 18m isobath, & OCS waters from 18m isobath to 9.3km past the 18m isobath)	SEC	One team data analyzed with line-transect theory	N	Scott *et al.* 1989
30	1991–1994	Apr–Jun	Ship (Oregon II)	22,041	Northern Gulf of America (from 200m to U.S. EEZ)	SEC	One team data analyzed by DISTANCE	N	Hansen *et al.* 1995
31	1992–1993	Sep–Oct	Plane (Twin Otter)		Northern Gulf of America bays & sounds (coastal waters from shoreline to 18m isobath, & OCS waters from 18m isobath to 9.3km past the 18m isobath)	GOMEX92, GOMEX93	One team data analyzed by DISTANCE	N	Blaylock and Hoggard 1994
33	1996–1997, 1999–2001	Apr–Jun	Ship (Oregon II & Gunter)	12,162	Northern Gulf of America (from 200m to U.S. EEZ)	SEC	One team data analyzed by DISTANCE	N	Mullin and Fulling 2004
34	1998–2001	End of Aug–Early Oct	Ship (Gunter & Oregon II)	2,196	Northern Gulf of America (OCS waters from 20–200 m)	SEC	One team data analyzed by DISTANCE	N	Fulling *et al.* 2003
36	2004	12Jan–13 Jan	Helicopter		Sable Island	DFO	Pup count	na	Bowen *et al.* 2007
37	2004		Plane		Gulf of St Lawrence & Nova Scotia Eastern Shore	DFO	Pup count	na	Hammill 2005
38	2009	10Jun–13Aug	Ship	4,600	Northern Gulf of America (from 200m to U.S. EEZ)	SEC	One team data analyzed by DISTANCE		
39	2007	17Jul–08Aug	Plane		Northern Gulf of America (from shore to 200m, majority of effort 0–20mi)	SEC	One team data analyzed by DISTANCE		
40	2011	04Jun–01Aug	Ship (Bigelow)	3,107	Virginia to Massachusetts (waters that were deeper than the 100m depth contour out to beyond the US EEZ)	NEC	Two-independent teams, both using big-eyes. Analyzed using DISTANCE, the independent observer option assuming point independence	Y	Palka 2012
41	2011	07Aug–26Aug	Plane (Twin Otter)	5,313	Massachusetts to New Brunswick, Canada (waters north of New Jersey & shallower than the 100m depth	NEC	Two-independent teams, both using naked eye in the same plane. Analyzed using DISTANCE, the independent observer option assuming point independence.	Y	Palka 2012

Survey Number	Year(s)	Time of Year	Platform	Track Line Length (km)	Area	Agency/ Program	Analysis	Corrected for g(0)	Reference(s)
					contour, through the US & Canadian Gulf of Maine & up to & including the lower Bay of Fundy)				
42	2011	19Jun–01Aug	Ship (Gunter)	4,445	Florida to Virginia	SEC	Two-independent teams, both using naked eye in the same plane. Analyzed using DISTANCE, the independent observer option assuming point independence.	Y	Garrison 2016
43	2012	May–Jun	Plane		Maine Coast	NEC	Corrected counts	N	Waring *et al.* 2015
44	1992	Jan–Feb	Ship (Oregon II)	3,464	Cape Canaveral to Cape Hatteras, US EEZ	SEC		N	NMFS 1992
45	2010	24Jul–14Aug	Plane	7,944	Southeastern Florida to Cape May, New Jersey	SEC	Two-independent teams, both using naked eye in the same plane. Analyzed using DISTANCE, the independent observer option assuming point independence.		
46	2011	06Jul–29Jul	Plane	8,665	Southeastern Florida to Cape May, New Jersey	SEC	Two-independent teams, both using naked eye in the same plane. Analyzed using DISTANCE, the independent observer option assuming point independence.		Garrison 2016
47	2016	27Jun–25Aug	Ship & Plane	5,354	Central Virginia to the lower Bay of Fundy	NEC	Two-independent teams. Analyzed using DISTANCE, the independent observer option assuming point independence.		Palka 2020
48	2016	30Jun–19Aug	Ship & Plane	4,399	Central Florida to Virginia	SEC	Two-independent teams. Analyzed using DISTANCE, the independent observer option assuming point independence.		Garrison 2020
49	2016	Aug & Sep	Plane	50,160	Gulf of St. Lawrence, Bay of Fundy, Scotian Shelf, Newfoundland, Labrador	DFO	NAISS		Lawson and Gosselin 2018
50	2017, 2018	02Jul–25Aug 2017, 11Aug–06Oct 2018	Ship (Gunter)	13,775	Northern Gulf of America (waters from 200m to U.S. EEZ)	SEC	Two-independent teams. Analyzed using DISTANCE, the independent observer option assuming point independence.	Y	Garrison *et al.* 2020
51	2017, 2018	29Jun–17Aug 2017 18Jan–14Mar 2018 12Oct–28Nov 2018	Plane	14,590 km 8,046 km 10,781 km	Northern Gulf of America (from shore to 200m, majority of effort 0–20m)	SEC	Two-independent teams, both using naked eye in the same plane. Analyzed using DISTANCE, the independent observer option assuming point independence.	Y	Garrison *et al.* 2021
52	2021	27Jun–23Aug 2021	Ship (Bigelow)	5,871 km	New Jersey to lower Bay of Fundy	NEC	Two-independent teams. Analyzed using DISTANCE, the independent observer option assuming point independence.	Y	NEFSC and SEFSC 2022

Survey Number	Year(s)	Time of Year	Platform	Track Line Length (km)	Area	Agency/ Program	Analysis	Corrected for g(0)	Reference(s)
53	2021	12Jun–5Sep 2021	Ship (Gunter)	5,659 km	central Florida to New Jersey	SEC	Two-independent teams. Analyzed using DISTANCE, the independent observer option assuming point independence.	Y	NEFSC and SEFSC 2022
54	2021	18Jun–14Sep 2021	Plane	9,318 km	central Florida to New Jersey	SEC	Two-independent teams. Analyzed using DISTANCE, the independent observer option assuming point independence.	Y	Garrison and Dias 2024

Appendix IV: Table B. Abundance Estimates.

"Survey Number" refers to surveys described in Table A. "Best" estimate for each species is in bold font.

Species	Stock	Year	Nest	CV	Survey Number	Notes
Humpback Whale	Gulf of Maine	1992	501			Minimum population size estimated from photo-ID data
		1993	652	0.29		YONAH sampling (Clapham *et al.* 2003)
		1997	497			Minimum population size estimated from photo-ID data
		1999	902	0.45	17	
		2002	521	0.67	18	Palka 2006
		2004	359	0.75	22	Palka 2006
		2006	847	0.55	23	Palka 2005
		2008	823			Mark-recapture estimate (Robbins 2010)
		2011	335	0.42	40+41	Palka 2012
		2015	896			Minimum population size estimated from photo-ID data
		2016	2,368			
		2016	1,396	na		State-space mark-recapture (Pace 2017)
Fin Whale	Western North Atlantic	1995	2,200	0.24	12	Palka 1996
		1999	2,814	0.21	18	Palka 2006
		2002	2,933	0.49	18	Palka 2006
		2004	1,925	0.55	22	Palka 2006
		2006	2,269	0.37	23	Palka 2005
		2007	3,522	0.27	25	Lawson and Gosselin 2009
		2011	1,595	0.33	40+41	Palka 2012
		2011	23	0.87	42	
		2011	1,618	0.33	40+41+42	Estimate summed from north and south surveys
		2016	3,006	0.40	47+48	Garrison 2020; Palka 2020
		2016	2,235	0.41	49	Bay of Fundy/Scotian Shelf (Lawson and Gosselin 2018)
		2016	2,177	0.47	49	Newfoundland/Labrador (Lawson and Gosselin 2018)
		2016	**7,418**	**0.25**	**47+48+49**	
		2021	2,240	0.39	52	Palka 2023
		2021	12	1.02	53	Garrison and Dias 2023
		2021	**2,252**	**0.39**	**52+53**	Garrison and Dias 2023; Palka 2023; Estimate summed from north and south surveys
Sei Whale	Nova Scotia Stock	1977	1,393–2,248			Based on tag-recapture data (Mitchell and Chapman 1977)
		1977	870			Based on census data (Mitchell and Chapman 1977)
		1982	280		1	CETAP 1982
		2002	71	1.01	18	Palka 2006
		2004	386	0.85	22	Palka 2006
		2006	207	0.62	23	Palka 2005
		2011	357	0.52	40+41	Palka 2012
		2010– 2013	**6,292**	**1.02**		Springtime average abundance estimate generated from spatially- and temporally-explicit density models derived from visual two-team abundance survey data collected between 2010 and 2013 (Palka *et al.* 2017)
		1999– 2013	627	0.14		Spring habitat-based density estimates (Roberts *et al*. 2016)

Species	Stock	Year	Nest	CV	Survey Number	Notes
		1995– 2013	717	0.30		Summer habitat-based density estimates (Roberts *et al*. 2016)
		2016	28	0.55	47	Palka 2016
		2021	34	0.99	52	Palka 2023
Minke Whale	Canadian East Coast	1982	320	0.23	1	CETAP 1982
		1992	2,650	0.31	3+8	
		1993	330	0.66	9	
		1995	2,790	0.32	12	Palka 1996
		1995	1,020	0.27	11	
		1996	620	0.52	13	
		1999	2,998	0.19	17	
		2002	756	0.9	18	Palka 2006
		2004	600	0.61	22	Palka 2006
		2006	3,312	0.74	23	
		2007	20,741	0.3	25	Lawson and Gosselin 2009
		2011	2,591	0.81	40+41	Palka 2012
		2016	5,036	0.68	47	Palka 2020
		2016	6,158	0.40	49	Bay of Fundy/Scotian Shelf (Lawson and Gosselin 2018)
		2016	13,008	0.46	49	Newfoundland/Labrador (Lawson and Gosselin 2018)
		2016	**24,202**	**0.30**	**47+49**	
		2021	5,630	0.58	52	Palka 2023
Sperm Whale	North Atlantic	1982	219	0.36	1	CETAP 1982
		1990	338	0.31	2	
		1991	736	0.33	7	Waring *et al.*1992, Warring 1998
		1991	705	0.66	6	
		1991	337	0.5	5	
		1993	116	0.4	9	
		1994	623	0.52	10	
		1995	2,698	0.67	12	Palka 1996
		1998	2,848	0.49	16	
		1998	1,181	0.51	14	Mullin and Fulling 2003
		2004	2,607	0.57	22	Palka 2006
		2004	2,197	0.47	21	Garrison *et al.* 2010
		2004	4,804	0.38	21+22	Estimate summed from north and south surveys
		2011	1,593	0.36	40+41	Palka 2012
		2011	695	0.39	42	
		2011	2,288	0.28	40+41+42	Estimate summed from north and south surveys
		2016	3,321	0.35	47	Palka 2020
		2016	1,028	0.35	48	Garrison 2020
		2016	4,349	0.28	47+48	Estimate summed from north and south surveys
		2021	3,789	0.38	52	Palka 2023
		2021	2,106	0.44	53	Garrison and Dias 2023
		2012	**5,895**	**0.29**	**52+53**	Garrison and Dias 2023; Palka 2023; Estimate summed from north and south surveys

Species	Stock	Year	Nest	CV	Survey Number	Notes
***Kogia* spp.**	Western North Atlantic	1998	115	0.61	16	
		1998	580	0.57	14	Mullin and Fulling 2003
		2004	358	0.44	22	Palka 2006
		2004	37	0.75	21	Garrison *et al.* 2010
		2004	395	0.4	21+22	Estimate summed from north and south surveys
		2011	1,783	0.62	40+41	Palka 2012
		2011	2,002	0.69	42	
		2011	3,785	0.47	40+41+42	Estimate summed from north and south surveys
		2016	4,548	0.49	47	Palka 2020
		2016	3,202	0.59	48	Garrison 2020
		2016	7,750	0.38	47+48	Estimate summed from north and south surveys
		2021	**9,474**	**0.36**	**52+53**	Estimate summed from north and south surveys
Beaked Whales	Western North Atlantic	1982	120	0.71	1	CETAP 1982
		1990	442	0.51	2	
		1991	262	0.99	7	Waring *et al.*1992, Warring 1998
		1991	370	0.65	6	
		1991	612	0.73	5	
		1993	330	0.66	9	
		1994	99	0.64	10	
		1995	1,519	0.69	12	Palka 1996
		1998	2,600	0.4	16	
		1998	541	0.55	14	Mullin and Fulling 2003
		2004	2,839	0.78	22	Palka 2006
		2004	674	0.36	21	Garrison *et al.* 2010
		2004	3,513	0.63	21+22	Estimate summed from north and south surveys
		2006	922	1.47	23	
		2011	5,500	0.67	40+41	2011 estimates are for *Mesoplodon* spp. beaked whales alone (not including *Ziphias*; Palka 2012)
		2011	1,592	0.67	42	2011 estimates are for *Mesoplodon* spp. beaked whales alone (not including *Ziphias*)
		2011	7,092	0.54	40+41+42	2011 estimates are for *Mesoplodon* spp. beaked whales alone (not including *Ziphias*); Estimate summed from north and south surveys
		2016	6,760	0.37	47	Palka 2020
		2016	3,347	0.29	48	Garrison 2020
		2016	10,107	0.27	47+48	Estimate summed from north and south surveys
Cuvier's Beaked Whale	Western North Atlantic	2011	4,962	0.37	40+41	Palka 2012
		2011	1,570	0.65	42	
		2011	6,532	0.32	40+41+42	Estimate summed from north and south surveys
		2016	3,897	0.47	47	Palka 2020
		2016	1,847	0.49	48	Garrison 2020
		2016	5,744	0.36	47+48	Estimate summed from north and south surveys
		2021	**1,742**	**0.39**	**52**	Palka 2023
		2021	**2,928**	**0.31**	**53**	Garrison and Dias 2023

Species	Stock	Year	Nest	CV	Survey Number	Notes
		2021	**4,670**	**0.24**	**52+53**	Garrison and Dias 2023; Palka 2023; Estimate summed from north and south surveys
Risso's Dolphin	Western North Atlantic	1982	4,980	0.34	1	CETAP 1982
		1991	11,017	0.58	7	Waring *et al.*1992, Warring 1998
		1991	6,496	0.74	5	
		1991	16,818	0.52	6	
		1993	212	0.62	9	
		1995	5,587	1.16	12	Palka 1996
		1998	18,631	0.35	17	
		1998	9,533	0.5	15	
		1998	28,164	0.29	15+17	Estimate summed from north and south surveys
		2002	69,311	0.76	18	Palka 2006
		2004	15,053	0.78	21	Garrison *et al.* 2010
		2004	5,426	0.54	22	Palka 2006
		2004	20,479	0.59	21+22	Estimate summed from north and south surveys
		2006	14,408	0.38	23	
		2011	15,197	0.55	40+41	Palka 2012
		2011	3,053	0.44	42	
		2011	18,250	0.46	40+41+42	Estimate summed from north and south surveys
		2016	7,245	0.44	48	Garrison 2020
		2016	22,175	0.23	47	Palka 2020
		2016	6,073	0.45	49	Lawson and Gosselin 2018
		2016	**35,493**	**0.19**	**47+48+49**	
		2021	**39,612**	**0.5**	**52**	Palka 2023
		2021	**4,455**	**0.45**	**53**	Garrison and Dias 2023
		2021	**44,067**	**0.45**	**52+53**	Garrison and Dias 2023; Palka 2023; Estimate summed from north and south surveys
Pilot Whale	Western North Atlantic	1951	50,000			Derived from catch data from 1951–1961 drive fishery (Mitchell 1974)
		1975	43,000–96,000			Derived from population models (Mercer 1975)
		1982	11,120	0.29	1	CETAP 1982
		1991	3,636	0.36	7	Waring *et al.*1992, Warring 1998
		1991	3,368	0.28	5	
		1991	5,377	0.53	6	
		1993	668	0.55	9	
		1995	8,176	0.65	12	Palka 1996
		1995	9,776	0.55	12+16	Sum of US (#12) and Canadian (#16) surveys
		1998	1,600	0.65	16	
		1998	9,800	0.34	17	
		1998	5,109	0.41	15	
		2002	5,408	0.56	18	Palka 2006
		2004	15,728	0.34	22	Palka 2006

Species	Stock	Year	Nest	CV	Survey Number	Notes
		2004	15,411	0.43	21	Garrison *et al.* 2010
		2004	31,139	0.27	21+22	Estimate summed from north and south surveys
		2006	26,535	0.35	23	Estimate summed from north and south surveys
		2007	16,058	0.79	25	Long-finned pilot whales (Lawson and Gosselin 2009)
		2011	5,636	0.63	40+41	Long-finned pilot whales
		2011	11,865	0.57	40+41	Unidentified pilot whales
		2011	4,569	0.57	40+41	Short-finned pilot whales
		2011	16,946	0.43	42	Short-finned pilot whales
		2011	21,515	0.37	40+41+42	Best estimate for short-finned pilot whales alone; Estimate summed from north and south surveys
		2016	3,810	0.42	47	Short-finned pilot whales (Garrison and Palka 2018)
		2016	25,114	0.27	48	Short-finned pilot whales (Garrison and Palka 2018)
		2016	28,924	0.24	47+48	Best estimate for short-finned pilot whales alone; Estimate summed from north and south surveys
		2016	10,997	0.51	47	Long-finned pilot whales (Garrison 2020; Palka 2020)
		2016	28,218	0.36	48	Long-finned pilot whales (Garrison 2020; Palka 2020)
		2016	39,215	0.30	47+48	Best estimate for long-finned pilot whales alone; Estimate summed from north and south surveys
		2021	**18,726**	**0.33**	**52+53**	Best estimate for short-finned pilot whales alone; Estimate summed from north and south surveys
		2021	**5,711**	**0.62**	**52+53**	Best estimate for long-finned pilot whales alone; Estimate summed from north and south surveys
Atlantic White-sided Dolphin	Western North Atlantic	1982	28,600	0.21	1	
		1992	20,400	0.63	2+7	
		1993	729	0.47	9	
		1995	27,200	0.43	12	Palka 1996
		1995	11,750	0.47	11	
		1996	560	0.89	13	
		1999	51,640	0.38	17	
		2002	109,141	0.3	18	Palka 2006
		2004	2,330	0.8	22	Palka 2006
		2006	17,594	0.3	23	
		2006	63,368	0.27	(18+23)/2	Average of #18 and #23
		2007	5,796	0.43	25	Lawson and Gosselin 2009
		2011	48,819	0.61	40+41	Palka 2012
		2016	31,912	0.61	47	Palka 2020
		2016	61,321	1.04	49	Canadian part of Gulf of Maine and all of Gulf of St. Lawrence population (Lawson and Gosselin 2018)
		2016	**93,233**	**0.71**	**47+49**	
		2021	4,632	0.55	52	Palka 2023; less of the range covered than in 2016
White-beaked Dolphin	Western North Atlantic	1982	573	0.69	1	CETAP 1982
			5,500			Alling and Whitehead 1987
		1982	3,486	0.22		Alling and Whitehead 1987

Species	Stock	Year	Nest	CV	Survey Number	Notes
		2006	2,003	0.94	23	
		2007	11,842		25	
		2008			26	
		2016	**536,016**	**0.31**	**49**	Lawson and Gosselin 2018
Common Dolphin	Western North Atlantic	1982	29,610	0.39	1	
		1991	22,215	0.4	7	Waring *et al.*1992; Warring 1998
		1993	1,645	0.47	9	
		1995	6,741	0.69	12	Palka 1996
		1998	30,768	0.32	17	
		1998	0		15	
		2002	6,460	0.74	18	
		2004	90,547	0.24	22	Palka 2006
		2004	30,196	0.54	21	Garrison *et al.* 2010
		2004	120,743	0.23	21+22	Estimate summed from north and south surveys
		2006	84,000	0.36	24	
		2007	173,486	0.55	25	Lawson and Gosselin 2009
		2011	67,191	0.29	40+41	Palka 2012
		2011	2,993	0.87	42	
		2011	70,184	0.28	40+41+42	Estimate summed from north and south surveys
		2016	80,227	0.31	47	Palka 2020
		2016	900	0.57	48	Garrison 2020
		2016	48,574	0.48	49	Newfoundland/Labrador (Lawson and Gosselin 2018)
		2016	43,124	0.28	49	Bay of Fundy/Scotian Shelf (Lawson and Gosselin 2018)
		2016	172,825	0.21	47+48+49	Estimate summed from north, south and Canadian surveys
		2021	**3,722**	**0.67**	**52**	Palka 2023
		2021	**15,004**	**0.38**	**53**	Garrison and Dias 2023
		2021	**18,726**	**0.33**	**52+53**	Garrison and Dias 2023; Palka 2023; Estimate summed from north and south surveys
Atlantic Spotted Dolphin	Western North Atlantic	1982	6,107	0.27	1	CETAP 1982
		1995	4,772	1.27	12	Palka 1996
		1998	32,043	1.39	16	
		1998	14,438	0.63	14	Mullin and Fulling 2003
		2004	3,578	0.48	22	Palka 2006
		2004	47,400	0.45	21	Garrison *et al.* 2010
		2004	50,978	0.42	21+22	Estimate summed from north and south surveys
		2011	26,798	0.66	40+41	Palka 2012
		2011	17,917	0.42	42	
		2011	44,715	0.43	40+41+42	Estimate summed from north and south surveys
		2016	8,247	0.24	47	Palka 2020
		2016	31,674	0.33	48	Garrison 2020
		2016	39,921	0.27	47+48	Estimate summed from north and south surveys
		2021	**31,506**	**0.28**	**52+53**	Estimate summed from north and south surveys
	Western North Atlantic	1982	6,107	0.27	1	CETAP 1982

Species	Stock	Year	Nest	CV	Survey Number	Notes
Pantropical Spotted Dolphin		1995	4,772	1.27	12	Palka 1996
		1998	343	1.03	16	
		1998	12,747	0.56	14	Mullin and Fulling 2003
		2004	0		22	Palka 2006
		2004	4,439	0.49	21	Garrison *et al.* 2010
		2004	4,439	0.49	21+22	Estimate summed from north and south surveys
		2011	0	0	40+41	Palka 2012
		2011	3,333	0.91	42	
		2011	3,333	0.91	40+41+42	Estimate summed from north and south surveys
		2016	0	-	47	Palka 2020
		2016	6,593	0.52	48	Garrison 2020
		2016	6,593	0.52	47+48	Estimate summed from north and south surveys
		2021	**2,757**	**0.50**	**52+53**	Estimate summed from north and south surveys
Striped Dolphin	Western North Atlantic	1982	36,780	0.27	1	
		1995	31,669	0.73	12	Palka 1996
		1998	39,720	0.45	16	
		1998	10,225	0.91	14	Mullin and Fulling 2003
		2004	52,055	0.57	22	
		2004	42,407	0.53	21	Garrison *et al.* 2010
		2004	94,462	0.4	21+22	Estimate summed from north and south surveys
		2011	46,882	0.33	40+41	Palka 2012
		2011	7,925	0.66	42	
		2011	54,807	0.3	40+41+42	Estimate summed from north and south surveys
		2016	42,783	0.25	47	Palka 2020
		2016	24,163	0.66	48	Garrison 2020
		2016	67,036	0.29	47+48	Estimate summed from north and south surveys
Rough-toothed Dolphin	Western North Atlantic	2011	0	0	40+41	Palka 2012
		2011	271	1	42	
		2011	**271**	**1**	**40+41+42**	Estimate summed from north and south surveys
Bottlenose Dolphin	Western North Atlantic: Offshore	1998	16,689	0.32	16	
		1998	13,085	0.4	14	Mullin and Fulling 2003
		2002	26,849	0.19	20	
		2002	5,100	0.41	18	Palka 2006
		2004	9,786	0.56	22	Palka 2006
		2004	44,953	0.26	21	Garrison *et al.* 2010
		2006	2,989	1.11	23	
		2011	26,766	0.52	40+41	Palka 2012
		2011	50,766	0.55	42	
		2011	77,532	0.4	40+41+42	Estimate summed from north and south surveys
		2016	17,958	0.33	47	Palka 2020
		2016	44,893	0.29	48	Garrison 2020
		2016	62,851	0.23	47+48	Estimate summed from north and south surveys
		2021	**64,587**	**0.24**	**52+53**	Estimate summed from north and south surveys

Species	Stock	Year	Nest	CV	Survey Number	Notes
Bottlenose Dolphin	Western North Atlantic Northern Migratory Coastal	2016	6,639	0.41	48	Garrison *et al.* 2017
Bottlenose Dolphin	Western North Atlantic Southern Migratory Coastal	2016	3,751	0.60	48	Garrison *et al.* 2017
Bottlenose Dolphin	Western North Atlantic South Carolina/Georgia Coastal	2016	6,027	0.34	48	Garrison *et al.* 2017
		2021	**9,121**	**0.28**	**54**	Garrison and Dias 2024
Bottlenose Dolphin	Western North Atlantic Northern Florida Coastal	2016	877	0.49	48	Garrison *et al.* 2017
		2021	**3,619**	**0.35**	**54**	Garrison and Dias 2024
Bottlenose Dolphin	Western North Atlantic Central Florida Coastal	2016	1,218	0.35	48	Garrison *et al.* 2017
		2021	**2,541**	**0.46**	**54**	Garrison and Dias 2024
Bottlenose Dolphin	Western North Atlantic Bay, Sound and Estuarine (10 stocks)	Northern North Carolina Estuarine System (2013)	823	0.06		Gorgone *et al.* 2014
		Southern North Carolina Estuarine System (2006)	188	0.19		Urian *et al.* 2013
		Northern South Carolina Estuarine System (2016)	453	0.28		Silva *et al.* 2019
		Charleston Estuarine System (2005–2006)	289	0.03		Speakman *et al.* 2010
		Northern Georgia/Southern South Carolina Estuarine System	unknown	-		
		Central Georgia Estuarine System (2008–2009)	unknown	-		
		Southern Georgia Estuarine System (2008–2009)	unknown	-		
		Jacksonville Estuarine System	unknown	-		
		Indian River Lagoon Estuarine System (2016–2017)	1,032	0.03		Durden *et al.* 2021
		Biscayne Bay	241	0.04		Bowers et al. 2024
Harbor Porpoise	Gulf of Maine, Bay of Fundy	1991	37,500	0.29	3	Palka 1995
		1992	67,500	0.23	8	Smith *et al.* 1993
		1995	74,000	0.2	12	Palka 1996
		1995	12,100	0.26	11	
		1996	21,700	0.38	14	Mullin and Fulling 2003
		1999	89,700	0.22	17	Survey discovered portions of the range not previously surveyed (Palka 2006)
		2002	64,047	0.48	21	Palka 2006

Species	Stock	Year	Nest	CV	Survey Number	Notes
		2004	51,520	0.65	23	Palka 2006
		2006	89,054	0.47	24	
		2007	4,862	0.31	25	Lawson and Gosselin 2009
		2011	79,883	0.32	40+41	Palka 2012
		2016	75,079	0.38	47	Palka 2020
		2016	20,464	0.39	48	Garrison 2020
		2016	**95,543**	**0.31**	**47+48**	Estimate summed from north and south surveys
		2021	**85,765**	**0.53**	**52**	Palka 2023
Harbor Seal	Western North Atlantic	2001	99,340	0.097	27	Gilbert *et al.* 2005
		2012	**75,834**	**0.15**	**43**	Waring *et al.* 2015
Gray Seal	Western North Atlantic	1999	5,611		28	Barlas 1999
		2001	1,731		27	Gilbert *et al.* 2005
		2004	52,500	0.15	37	Gulf of St Lawrence and Nova Scotia Eastern Shore
		2004	208,720–223,220	0.08–0.14	36	Sable Island
		2012	331,000	95%CI= 263,000-458,000		Gulf of St Lawrence + Nova Scotia Eastern Shore + Sable Island (DFO 2013)
		2014	505,000	95%CI= 329,000–682,000		Gulf of St Lawrence + Nova Scotia Eastern Shore + Sable Island (DFO 2014)
		2016	424,300	95%CI= 263,600–578,300		Gulf of St Lawrence + Nova Scotia Eastern Shore + Sable Island (DFO 2017)
		2016	27,131	95%CI= 18,768–39,221		Derived from total population size to pup ratios in Canada applied to U.S. pup counts
		2021	**366,400**	**317,800-409,400**		Gulf of St. Lawrence and Scotian Shelf; DFO 2022
		2021	**27,911**	**NA**		US portion of the population; Wood et al. 2022
Rice's Whale	Northern Gulf of America	1991–1994	35	1.1	30	Hansen *et al.* 1995
		1996–2001	40	0.61	33	Mullin and Fulling 2004
		2003–2004	15	1.98	35	
		2009	33	1.07	38	
		2017–2018	51	0.50	50	Garrison *et al.* 2020a
Sperm Whale	Northern Gulf of America	1991–1994	530	0.31	30	Hansen *et al.* 1995
		1996–2001	1,349	0.23	33	Mullin and Fulling 2004
		2003–2004	1,665	0.2	35	
		2009	763	0.38	38	
		2017–2018	1,307	0.33	50	Garrison *et al.* 2020a
***Kogia* spp.**	Northern Gulf of America	1991–1994	547	0.28	30	Hansen *et al.* 1995
		1996–2001	742	0.29	33	Mullin and Fulling 2004
		2003–2004	453	0.35	35	
		2009	186	1.04	38	
		2017–2018	336	0.35	50	Garrison *et al.* 2020a
Cuvier's Beaked Whale	Northern Gulf of America	1991–1994	30	0.5	30	Hansen *et al.* 1995
		1996–2001	95	0.47	33	Mullin and Fulling 2004
		2003–2004	65	0.67	35	

Species	Stock	Year	Nest	CV	Survey Number	Notes
		2009	74	1.04	38	
		2017–2018	18	0.75	50	Garrison *et al.* 2020a
***Mesoplodon* spp.**	Northern Gulf of America	1996–2001	106	0.41	33	Mullin and Fulling 2004
		2003–2004	57	1.4	35	
		2009	149	0.91	38	
		2017–2018	98	0.46	50	Garrison *et al.* 2020a
Killer Whale	Northern Gulf of America	1991–1994	277	0.42	30	Hansen *et al.* 1995
		1996–2001	133	0.49	33	Mullin and Fulling 2004
		2003–2004	49	0.77	35	
		2009	28	1.02	38	
		2017–2018	267	0.75	50	Garrison *et al.* 2020a
False Killer Whale	Northern Gulf of America	1991–1994	381	0.62	30	Hansen *et al.* 1995
		1996–2001	1,038	0.71	33	Mullin and Fulling 2004
		2003–2004	777	0.56	35	
		2017–2018	494	0.79	50	Garrison *et al.* 2020a
Short-finned Pilot Whale	Northern Gulf of America	1991–1994	353	0.89	30	Hansen *et al.* 1995
		1996–2001	2,388	0.48	33	Mullin and Fulling 2004
		2003–2004	716	0.34	35	
		2009	2,415	0.66	38	
		2017–2018	1,321	0.43	50	Garrison *et al.* 2020a
Melon-headed Whale	Northern Gulf of America	1991–1994	3,965	0.39	30	Hansen *et al.* 1995
		1996–2001	3,451	0.55	33	
		2003–2004	2,283	0.76	35	
		2009	2,235	0.75	38	
		2017–2018	1,749	0.68	50	Garrison *et al.* 2020a
Pygmy Killer Whale	Northern Gulf of America	1991–1994	518	0.81	30	Hansen *et al.* 1995
		1996–2001	408	0.6	33	Mullin and Fulling 2004
		2003–2004	323	0.6	35	
		2009	152	1.02	38	
		2017–2018	613	1.15	50	Garrison *et al.* 2020a
Risso's Dolphin	Northern Gulf of America	1991–1994	2,749	0.27	30	Hansen *et al.* 1995
		1996–2001	2,169	0.32	33	Mullin and Fulling 2004
		2003–2004	1,589	0.27	35	
		2009	2,442	0.57	38	
		2017–2018	1,974	0.46	50	Garrison *et al.* 2020a
Pantropical Spotted Dolphin	Northern Gulf of America	1991–1994	31,320	0.2	30	Hansen *et al.* 1995
		1996–2001	91,321	0.16	33	Mullin and Fulling 2004
		2003–2004	34,067	0.18	35	
		2009	50,880	0.27	38	

Species	Stock	Year	Nest	CV	Survey Number	Notes
		2017–2018	37,195	0.24	50	Garrison *et al.* 2020a
Striped Dolphin	Northern Gulf of America	1991–1994	4,858	0.44	30	Hansen *et al.* 1995
		1996–2001	6,505	0.43	33	Mullin and Fulling 2004
		2003–2004	3,325	0.48	35	
		2009	1,849	0.77	38	
		2017–2018	1,817	0.56	50	Garrison *et al.* 2020a
Spinner Dolphin	Northern Gulf of America	1991–1994	6,316	0.43	30	Hansen *et al.* 1995
		1996–2001	11,971	0.71	33	Mullin and Fulling 2004
		2003–2004	1,989	0.48	35	
		2009	11,441	0.83	38	
		2017–2018	2,991	0.54	50	Garrison *et al.* 2020a
Clymene Dolphin	Northern Gulf of America	1991–1994	5,571	0.37	30	Hansen *et al.* 1995
		1996–2001	17,355	0.65	33	Mullin and Fulling 2004
		2003–2004	6,575	0.36	35	
		2009	129	1	38	
		2017–2018	513	1.03	50	Garrison *et al.* 2020a
Atlantic Spotted Dolphin	Northern Gulf of America	Oceanic (1991–1994)	3,213	0.44	30	Hansen *et al.* 1995
		Oceanic (1996–2001)	175	0.84	33	Mullin and Fulling 2004
		OCS (1998–2001)	37,611	0.28	34	Abundance estimate is from 2000-2001 surveys only (from Fulling *et al.* 2003). Current best population size estimate is unknown because data from the continental shelf portion of this species' range are more than 8 years old.
		Oceanic (2003–2004)	0	-	35	
		2009	2968	0.67	38	
		2017–2018	**21,506**	**0.26**	**50+51**	Garrison *et al.* 2020a and Garrison *et al.* 2021
Fraser's Dolphin	Northern Gulf of America	1991–1994	127	0.9	30	Hansen *et al.* 1995
		1996–2001	726	0.7	33	
		2003–2004	0	-	35	
		2009	0	-	38	
		2017–2018	213	1.03	50	Garrison *et al.* 2020a
Rough-toothed Dolphin	Northern Gulf of America	Oceanic (1991–1994)	852	0.31	30	
		Oceanic (1996–2001)	985	0.44	33	Mullin and Fulling 2004
		OCS (1998–2001)	1,145	0.83	34	Abundance estimate is from 2000-2001 surveys only (from Fulling *et al.* 2003). Current best population size estimate is unknown because data from the continental shelf portion of this species' range are more than 8 years old.
		Oceanic (2003–2004)	1,508	0.39	35	
		2009	624	0.99	38	
Bottlenose Dolphin	Northern Gulf of America: Oceanic	1996–2001	2,239	0.41	33	Mullin and Fulling 2004
		2003–2004	3,708	0.42	35	
		2009	5,806	0.39	38	

Species	Stock	Year	Nest	CV	Survey Number	Notes
		2017–2018	213	1.03	50	Garrison *et al.* 2020a
Bottlenose Dolphin	Northern Gulf of America: Continental Shelf	1998–2001	17,777	0.32	34	Abundance estimate is from 2000-2001 surveys only (from Fulling *et al.* 2003). Current best population size estimate is unknown because data from the continental shelf are more than 8 years old.
		2017–2018	**63,280**	**0.11**	**51**	Garrison *et al.* 2021
Bottlenose Dolphin	Northern Gulf of America: Coastal (3 stocks)	Eastern (1994)	9,912	0.12	32	
		Eastern (2007)	7,702	0.19	39	
		Eastern (2017–2018)	**16,407**	**0.17**	**51**	Garrison *et al.* 2021
		Northern (1993)	4,191	0.21	31	Current best population size estimate for this stock is unknown because data are more than 8 years old (Blaylock and Hoggard 1994)
		Northern (2007)	2,473	0.25	39	
		Northern (2017–2018)	**11,543**	**0.19**	**51**	Garrison *et al.* 2021
		Western (1992)	3,499	0.21	31	Current best population size estimate for this stock is unknown because data are more than 8 years old (Blaylock and Hoggard 1994)
		Western (2017–2018)	**20,759**	**0.13**	**51**	Garrison *et al.* 2021
Bottlenose Dolphin	Northern Gulf of America: Bay, Sound and Estuarine (32 stocks)	Choctawhatchee Bay (2007)	179	0.04		Conn *et al.* 2011
		St. Joseph Bay (2011)	142	0.17		Balmer *et al. 2018*
		Sarasota Bay, Little Sarasota Bay (2015)	158	0.27		Tyson and Wells 2016
		Florida Bay	unk	-		
		Mississippi River Delta (2017–2018)	1,446	0.19	51	Garrison *et al.* 2021
		Mississippi Sound, Lake Borgne, Bay Boudreau (2018)	1,265	0.35	51	Garrison *et al.* 2021
		Barataria Bay (2019)	2,071	0.06		Garrison *et al.* 2020b
		West Bay (2014–2015)	37	0.05		Ronje *et al.* 2020
		Galveston Bay, East Bay, Trinity Bay (2016)	842	0.8		Ronje *et al.* 2020
		Terrebonne Bay, Timbalier Bay (2016)	3,870	0.15		Litz *et al.* 2018
		St. Andrew Bay (2016)	199	0.09		Balmer *et al.* 2019
		Sabine Lake (2017)	122	0.19		Ronje *et al.* 2020

Species	Stock	Year	Nest	CV	Survey Number	Notes
		Remaining 20 stocks	unknown	-	31	Current best population size estimate for each of these 20 stocks is unknown because data are more than 8 years old (Blaylock and Hoggard 1994)

References Cited (For Appendix IV - Tables A and B)

Alling, A.K. and H.P. Whitehead. 1987. A preliminary study of the status of white-beaked dolphins, *Lagenorhynchus albirostris*, and other small cetaceans off the coast of Labrador. Can. Field-Nat. 101:131–135.

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.

Balmer, B., S. Watwood, B. Quigley, T. Speakman, K. Barry, K. Mullin, P. Rosel, C. Sinclair, E. Zolman and L. Schwacke. 2019. Common bottlenose dolphin (*Tursiops truncatus)* abundance and distribution patterns in St. Andrew Bay, Florida, USA. Aquat. Conserv.: Mar. Freshw. Ecosyst. 2019:1–13.

Barlas, M.E. 1999. The distribution and abundance of harbor seals (*Phoca vitulina concolor*) and gray seals (*Halichoerus grypus*) in southern New England, winter 1998–summer 1999. M.A. thesis. Graduate School of Arts and Sciences Boston University, Boston, MA. 52 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. Manag. 13(1):19–30.

Blaylock, R.A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Memo. NMFS-SEFSC-356. 10 pp.

Bowen, W.D., J.I. McMillan and W. Blanchard. 2007. Reduced population growth of gray seals at Sable Island: Evidence from pup production and age of primiparity. Mar. Mamm. Sci. 23:48–64.

Bowers, M., A. Brossard, J. Wicker, L. Garrison and J. Litz. 2024. Biscayne Bay, Florida common bottlenose dolphin abundance estimate: 2019. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2024-03. 12 pp. https://repository.library.noaa.gov/view/noaa/67190

CETAP [Cetacean and Turtle Assessment Program]. 1982. A characterization of marine mammals and turtles in the mid- and north-Atlantic areas of the U.S. outer continental shelf, final report. Washington, DC, Bureau of Land Management. #AA551-CT8-48. 538 pp.

Clapham, P.J., J. Barlow, T. Cole, D. Mattila, R. Pace, D. Palka, J. Robbins and R. Seton. 2003. Stock definition, abundance and demographic parameters of humpback whales from the Gulf of Maine. J. Cetacean Res. Manag. 5:13–22.

Conn, P.B., A.M. Gorgone, A.R. Jugovich, B.L. Byrd and L.J. Hansen. 2011. Accounting for transients when estimating abundance of bottlenose dolphins in Choctawhatchee Bay, Florida. J. Wild. Manage. 75(3): 569–579.

DFO [Fisheries and Oceans Canada]. 2013. Stock assessment of Northwest Atlantic grey seals (*Halichoerus grypus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/008.

DFO [Department of Fisheries and Oceans]. 2022. Stock assessment of Northwest Atlantic grey seals (Halichoerus grypus) in Canada in 2021. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2022/018.

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.

Fulling, G.L., K.D. Mullin and C.W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101:923–932.

Garrison, L.P., A. Martinez and K. Maze-Foley. 2010. Habitat and abundance of cetaceans in Atlantic Ocean continental slope waters off the eastern USA. J. Cetacean Res. Manag. 11(3):267–277.

Garrison, L.P. 2016. Abundance of marine mammals in waters of the U.S. east coast during summer 2011. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution #PRBD-2016-08. 21pp. Available from: https://repository.library.noaa.gov/view/noaa/24394

Garrison, L.P., K. Barry and W. Hoggard. 2017. The abundance of coastal morphotype bottlenose dolphins on the U.S. east coast: 2002-2016. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2017-01. 37 pp. Available from: https://repository.library.noaa.gov/view/noaa/50343

Garrison, L.P. and D. Palka. 2018. Abundance of short-finned pilot whales along the U.S. east coast from summer 2016 vessel surveys. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2018-07. 18pp. Available from: https://repository.library.noaa.gov/view/noaa/50344

Garrison, L.P. 2020. Abundance of cetaceans along the southeast U.S. east coast from a summer 2016 vessel survey. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRD Contribution # PRD-2020-04. 17pp.

Garrison, L.P., J. Ortega-Ortiz and G. Rappucci. 2020a. Abundance of marine mammals in the waters of the U.S. Gulf of Mexico in the summers 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. 55pp. Available from: https://repository.library.noaa.gov/view/noaa/26505

Garrison, L.P, J. Litz, J. and C. Sinclair. 2020b. Predicting the effects of low salinity associated with the MBSD project on resident common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, LA. NOAA Tech. Memo. NOAA NMFS-SEFSC-748. 97 pp. Available from: https://repository.library.noaa.gov/view/noaa/27907

Garrison, L.P., J. Ortega-Ortiz and G. Rappucci. 2021. Abundance of coastal and continental shelf stocks of common bottlenose and Atlantic spotted dolphins in the northern Gulf of Mexico: 2017-2018. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, Florida 33140. PRD-2021-01. 25 pp. Available from: https://repository.library.noaa.gov/view/noaa/43721

Garrison, L.P. and L.A. Dias. 2023. Abundance of marine mammals in waters of the southeastern U.S. Atlantic during summer 2021. SEFSC MMTD Contribution: #MMTD-2023-01. 23 pp. https://repository.library.noaa.gov/view/noaa/49152

Garrison, L.P. and L.A. Dias. 2024. Abundance of Tamanend's bottlenose dolphins (*Tursiops erebennus*) along the U.S. Atlantic Coast from aerial surveys conducted during summer 2021. Southeast Fisheries Science Center, Marine Mammal and Turtle Division, 75 Virginia Beach Dr., Miami, FL 33140. MMTD Contribution # MMTD-2024-04. 25 pp.

Gilbert, J.R., G.T. Waring, K.M. Wynne and N. Guldager. 2005. Changes in abundance and distribution of harbor seals in Maine, 1981–2001. Mar. Mamm. Sci. 21:519–535.

Gorgone, A.M., T. Eguchi, B.L. Byrd, K.M. Altman and A.A. Hohn. 2014. Estimating the abundance of the Northern North Carolina Estuarine System Stock of common bottlenose dolphins (*Tursiops truncatus*). NOAA Tech. Memo. NMFS-SEFSC-664. 22 pp.

Hammill, M.O. 2005. Abundance of Northwest Atlantic grey seals in the Gulf of St. Lawrence and along the Nova Scotia Eastern Shore. Fisheries and Oceans Canada. Ottawa, Ontario. DFO Research Document 2005/036. 11pp.

Hansen, L.J., K.D. Mullin and C.L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami, FL. Contribution No. MIA-94/95-25. 19pp.

Kingsley, M.C.S. and R.R. Reeves. 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76:1529–1550.

Lawson, J.W. and J.-F. Gosselin. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's marine megafauna survey - A component of the 2007 TNASS. DFO Can. Sci. Advisory Sec. Res. Doc. 2009/031. 33pp.

Lawson, J. and J.-F. Gosselin. 2018. Estimates of cetacean abundance from the 2016 NAISS aerial surveys of eastern Canadian waters, with a comparison to estimates from the 2007 TNASS. NAAMCO SC/25/AE/09. 40pp.Litz, J., C. Sinclair and L. Garrison. 2018. Terrebonne-Timbalier Bay, Louisiana, common bottlenose dolphin abundance estimate: 2016. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2018-03, 10 pp. Available from: https://grunt.sefsc.noaa.gov/P_QryLDS/download/PRB94_PRBD_2018-03-C.pdf?id=LDS

McDonald, T.L., F.E. Hornsby, T.R. Speakman, E.S. Zolman, K.D. Mullin, C. Sinclair, P.E. Rosel, L. Thomas and L.H. Schwacke. 2017. Survival, density, and abundance of common bottlenose dolphins in Barataria Bay following the *Deepwater Horizon* oil spill. Endanger. Species Res. 33:193–209.

Mercer, M.C. 1975. Modified Leslie-DeLury population models of the long-finned pilot whale (*Globicephala melaena*) and annual production of the short-finned squid (*Illex illecebrosus*) based upon their interactions at Newfoundland. J. Fish. Res. Board Can. 32(7):1145–1154.

Mitchell, E. 1974. Present status of northwest Atlantic fin and other whale stocks. Pages 108–169 *in*: W.E. Schevill (Ed.). The whale problem: A status report. Harvard University Press, Cambridge, MA.

Mitchell, E. and D.G. Chapman. 1977. Preliminary assessment of stocks of northwest Atlantic sei whales (*Balaenoptera borealis*). Rep. Int. Whal. Comm. (Special Issue) 1:117–120.

Mullin, K.D. 2017. Abundance of the Mississippi Sound, Lake Borgne, Bay Boudreau common bottlenose dolphin stock: July 2010–May 2012. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2017-05. 11pp.

Mullin, K.D. and G.L. Fulling. 2003. Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull. 101:603–613.

Mullin, K.D. and G.L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico, 1996-2001. Mar. Mamm. Sci. 20(4):787–807.

NMFS [National Marine Fisheries Service]. 1990. Cruise results, NOAA ship *Chapman*, Cruise No. 90-05. Marine Mammal Sighting Survey. National Marine Fisheries Service. National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543. 5pp.

NMFS [National Marine Fisheries Service]. 1991. Northeast cetacean aerial survey and inter-platform study. NOAA-NMFS-SEFSC and NEFSC. 4 pp.

NMFS [National Marine Fisheries Service]. 1993. Cruise results, NOAA ship *Delaware II*, Cruise No. DEL 93-06, Marine Mammal Survey. National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543. 5pp.

NMFS [National Marine Fisheries Service]. 1994. Cruise results, NOAA ship *Relentless*, Cruise No. RS 9402, Marine Mammal Survey/Warm Core Ring Study. National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543. 8pp.

Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2022. 2021 Annual report of a comprehensive assessment of marine mammal, marine turtle, and seabird abundance and spatial distribution in US waters of the Western North Atlantic Ocean – AMAPPS III. 125 pp. https://repository.library.noaa.gov/view/noaa/41734

Palka, DL. 2023. Cetacean abundance in the US Northwestern Atlantic Ocean, Summer 2021. Northeast Fish. Sci. Cent. Ref. Doc. 23-08. 67pp. https://repository.library.noaa.gov/view/noaa/50424

Palka, D.L. 1995. Abundance estimate of Gulf of Maine harbor porpoise. Rep. Int. Whal. Commn. (Special Issue) 16:27–50.

Palka, D.L. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. Northeast Fish. Sci. Cent. Ref. Doc. 96-04. 35pp. Available from: https://repository.library.noaa.gov/view/noaa/4008

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41pp. Available from: https://repository.library.noaa.gov/view/noaa/5258

Palka, D.L. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. Northeast Fish. Sci. Cent. Ref. Doc. 12-29. 37pp. Available from: https://repository.library.noaa.gov/view/noaa/4312

Palka, D.L., S. Chavez-Rosales, E. Josephson, D. Cholewiak, H.L. Haas, L. Garrison, M. Jones, D. Sigourney, G. Waring, M. Jech, E. Broughton, M. Soldevilla, G. Davis, A. DeAngelis, C.R. Sasso, M.V. Winton, R.J. Smolowitz, G. Fay, E. LaBrecque, J.B. Leiness, Dettloff, M. Warden, K. Murray, and C. Orphanides. 2017. Atlantic Marine Assessment Program for Protected Species: 2010–2014. OCS Study BOEM 2017-071. US Dept. of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region, Washington, DC. 211pp. Available from: https://espis.boem.gov/final%20reports/5638.pdf

Palka, D. 2020. Cetacean abundance in the US northwestern Atlantic Ocean summer 2016. Northeast Fish. Sci. Cent. Ref. Doc. 20-05. 60pp.

Roberts, J.J., B.D. Best, L. Mannocci, E. Fujioka, P.N. Halpin, D.L. Palka, L.P. Garrison, K.D. Mullin, T.V.N. Cole, C.B. Khan, W.A. McLellan, D.A. Pabst and G.G. Lockhart. 2016. Habitat-based cetacean density models for the US Atlantic and Gulf of Mexico. Sci. Rep. 6:22615.

Ronje, E.I., H.R. Whitehead, K. Barry, S. Piwetz, J. Struve, V. Lecours, L.P. Garrison, R.S. Wells and K.D. Mullin. 2020. Abundance and occurrence of common bottlenose dolphins (Tursiops truncatus) in three estuaries of the northwestern Gulf of Mexico. Gulf and Caribbean Research 31:18–34.

Scott, G.P., D.M. Burn, L.J. Hansen and R.E. Owen. 1989. Estimates of bottlenose dolphin abundance in the Gulf of Mexico from regional aerial surveys. CRD 88/89-07. NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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.

Smith, T., D. Palka and K. Bisack. 1993. Biological significance of bycatch of harbor porpoise in the Gulf of Maine demersal gillnet fishery. Northeast Fish. Sci. Cent. Ref. Doc. 93-23. 15pp.

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.

Tyson, R.B., S.M. Nowacek and D.P. Nowacek. 2011. Community structure and abundance of bottlenose dolphins *Tursiops truncatus* in coastal waters of the northeast Gulf of Mexico. Mar. Ecol. Prog. Ser. 438:253–265.Tyson, R.B. and R.S. Wells. 2016. Sarasota Bay/Little Sarasota Bay bottlenose dolphin abundance estimates: 2015. Prepared for National Marine Fisheries Service, northern Gulf of Mexico bay, sound, and estuary bottlenose dolphin stock blocks B20 and B35, combined. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRBD Contribution # PRBD-2016-02, 21 pp. Available from: https://www.sefsc.noaa.gov/P_QryLDS/download/PRB84_PRBD-2016-02.pdf?id=LDS

Urian, K.W., D.M. Waples, R.B. Tyson, L.E. Willams Hodge and A.J. Read. 2013. Abundance of bottlenose dolphins (*Tursiops truncatus*) in estuarine and near-shore waters of North Carolina, USA. J. N. C. Acad. Sci. 129(4):165–171.

Waring, G.T. 1998. Results of the summer 1991 R/V *Chapman* marine mammal sighting survey. Northeast Fish. Sci. Cent. Ref. Doc. 98-09. 21pp.

Waring, G.T., C.P. Fairfield, C.M. Ruhsam and M. Sano. 1992. Cetaceans associated with Gulf Stream features off the Northeastern USA shelf. ICES [International Council for the Exploration of the Sea] C.M. 1992/N:12.

Waring, G.T., R.A. DiGiovanni Jr., E. Josephson, S. Wood and J.R. Gilbert. 2015. 2012 population estimate for the harbor seal (*Phoca vitulina concolor*) in New England waters. NOAA Tech. Memo. NMFS NE-235. 15pp.

Wells, R.S. 2009. Learning from nature: Bottlenose dolphin care and husbandry. Zoo Biol. 28:635–651.

Wood, S.A., E. Josephson, K. Precoda, and K.T. Murray. 2022 Gray seal (*Halichoerus grypus*) pupping trends and 2021 piopulation estimates in U.S. waters, FNEFSC ref doc 22-14; 16p.

Appendix V: Fishery Bycatch Summaries -- Part A: By Fishery

Northeast Sink Gillnet

	Harbor Porpoise		Bottlenose Dolphin, Atlantic Offshore Stock		White-sided Dolphin		Common Dolphin		Risso's Dolphin		Long-finned Pilot Whale		Harbor Seal		Gray Seal		Harp Seal	
Year	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV
1990	2900	0.32	0	0	0	0	0	0	0	0	0	0	602	0.68	0	0	0	0
1991	2000	0.35	0	0	49	0.46	0	0	0	0	0	0	231	0.22	0	0	0	0
1992	1200	0.21	0	0	154	0.35	0	0	0	0	0	0	373	0.23	0	0	0	0
1993	1400	0.18	0	0	205	0.31	0	0	0	0	0	0	698	0.19	0	0	0	0
1994	2100	0.18	0	0	240	0.51	0	0	0	0	0	0	1330	0.25	19	0.95	861	0.58
1995	1400	0.27	0	0	80	1.16	0	0	0	0	0	0	1179	0.21	117	0.42	694	0.27
1996	1200	0.25	0	0	114	0.61	63	1.39	0	0	0	0	911	0.27	49	0.49	89	0.55
1997	782	0.22	0	0	140	0.61	0	0	0	0	0	0	598	0.26	131	0.5	269	0.5
1998	332	0.46	0	0	34	0.92	0	0	0	0	0	0	332	0.33	61	0.98	78	0.48
1999	270	0.28	0	0	69	0.7	146	0.97	0	0	0	0	1446	0.34	155	0.51	81	0.78
2000	507	0.37	132	1.16	26	1	0	0	15	1.06	0	0	917	0.43	193	0.55	24	1.57
2001	53	0.97	0	0	26	1	0	0	0	0	0	0	1471	0.38	117	0.59	26	1.04
2002	444	0.37	0	0	30	0.74	0	0	0	0	0	0	787	0.32	0	0	0	0
2003	592	0.33	0	0	31	0.93	0	0	0	0	0	0	542	0.28	242	0.47	0	0
2004	654	0.36	1[a]	na	7	0.98	0	0	0	0	0	0	792	0.34	504	0.34	303	0.3
2005	630	0.23	0	0	59	0.49	5	0.8	15	0.93	0	0	719	0.2	574	0.44	35	0.68
2006	514	0.31	0	0	41	0.71	20	1.05	0	0	0	0	87	0.58	248	0.47	65	0.66
2007	395	0.37	0	0	0	0	11	0.94	0	0	0	0	92	0.49	886	0.24	119	0.35
2008	666	0.48	0	0	81	0.57	34	0.77	0	0	0	0	242	0.41	618	0.23	238	0.38
2009	591	0.23	0	0	0	0	43	0.77	0	0	0	0	513	0.28	1063	0.26	415	0.27
2010	387	0.27	0	0	66	0.9	42	0.81	0	0	3	.82	540	0.25	1155	0.28	253	0.61
2011	273	0.2	0	0	18	0.43	64	0.71	0	0	0	0	343	0.19	1491	0.22	14	0.46
2012	277.3	0.59	0	0	9	0.92	95	0.4	6	0.87	0	0	252	0.26	542	0.19	0	0
2013	399	0.33	27	5	4	1.03	104	0.47	23	0.97	0	0	147	0.3	1127	0.2	22	0.75
2014	128	0.27	0	0	10	0.66	111	0.46	0	0	0	0	390	0.39	917	0.14	17	0.53
2015	177	0.28	0	0	0	0	55	0.54	0	0	0	0	474	0.17	1021	0.25	119	0.34
2016	125	0.34	0	0	0	0	80	0.38	0	0	0	0	245	0.29	498	0.33	85	0.5
2017	136	0.28	8	0.92	0	0	133	0.28	0	0	0	0	298	0.18	930	0.16	44	0.37
2018	92	0.52	0	0	0	0	93	0.45	0	0	0	0	188	0.36	1113	0.32	14	0.8
2019	195	0.22	2	0.99	0	0	5	0.68	5	0.7	0	0	316	0.15	2019	0.17	163	0.19
2020	121	0.22	1	0.99	0	0	50	0.25	2	1.01	0	0	261	0.14	1357	0.14	72	0.22
2021	111	0.19	1.4	0.99	2	0	39	0.24	3	0	0	0	241	0.13	1027	0.14	66	0.24

	Harbor Porpoise		Bottlenose Dolphin, Atlantic Offshore Stock		White-sided Dolphin		Common Dolphin		Risso's Dolphin		Long-finned Pilot Whale		Harbor Seal		Gray Seal		Harp Seal	
Year	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV	M/SI (est)	CV
2022	118	0.22	0	0	2	0.43	22	0.36	4	0.64	0	0	185	0.18	522	0.12	0	0

Note: This table only includes observed bycatch. For a complete list of marine mammal species interactions with this fishery, please see https://www.fisheries.noaa.gov/national/marine-mammal-protection/northeast-sink-gillnet-fishery-mmpa-list-fisheries.
[a] Unextrapolated mortalities
na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

Mid-Atlantic Sink Gillnet

	Harbor Porpoise		Bottlenose Dolphin, Atlantic Offshore Stock		White-sided Dolphin		Common Dolphin		Risso's Dolphin		Pilot Whale, Unidentified		Harbor Seal		Gray Seal		Harp Seal		Minke Whale	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	103	0.57	56	1.66	0	0	7.4	0.69	0	0	0	0	0	0	0	0	0	0	0	0
1996	311	0.31	64	0.83	0	0	43	0.79	0	0	0	0	0	0	0	0	0	0	0	0
1997	572	0.35	0	0	45	0.82	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	446	0.36	63	0.94	0	0	0	0	0	0	7	0	11	0.77	0	0	17	1.02	0	0
1999	53	0.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	21	0.76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	26	0.95	na	na	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	unk	na	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	76	1.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	137	0.91	0	0	0	0	0	0	0	0	0	0	15	0.86	69	0.92	0	0	0	0
2005	470	0.51	1[a]	na	0	0	0	0	0	0	0	0	63	0.67	0	0	0	0	0	0
2006	511	0.32	0	0	0	0	0	0	0	0	0	0	26	0.98	0	0	0	0	0	0
2007	58	1.03	0	0	0	0	0	0	34	0.73	0	0	0	0	0	0	38	0.9	0	0
2008	350	0.75	0	0	0	0	0	0	0	0	0	0	88	0.74	0	0	176	0.74	0	0
2009	201	0.55	0	0	0	0	0	0	0	0	0	0	47	0.68	0	0	0	0	0	0
2010	259	0.88	0	0	0	0	30	0.48	0	0	0	0	89	0.39	267	0.75	0	0	0	0
2011	123	0.41	0	0	0	0	29	0.53	0	0	0	0	21	0.67	19	0.60	0	0	0	0
2012	63.41	0.83	0	0	0	0	15	0.93	0	0	0	0	0	0	14	0.98	0	0	0	0
2013	19	1.06	26	0.95	0	0	62	0.67	0	0	0	0	0	0	0	0	0	0	0	0
2014	22	1.03	0	0	0	0	17	0.86	0	0	0	0	19	1.06	22	1.09	0	0	0	0
2015	60	1.16	0	0	0	0	30	0.55	0	0	0	0	48	0.52	15	1.04	0	0	0	0
2016	23	0.64	0	0	0	0	7	0.97	0	0	0	0	18	0.95	7	0.93	0	0	0	0
2017	9	0.95	0	0	0	0	22	0.71	0	0	0	0	3	0.62	0	0	0	0	0	0
2018	0	0	0	0	0	0	8	0.91	0	0	0	0	26	0.52	0	0	0	0	0	0

	Harbor Porpoise		Bottlenose Dolphin, Atlantic Offshore Stock		White-sided Dolphin		Common Dolphin		Risso's Dolphin		Pilot Whale, Unidentified		Harbor Seal		Gray Seal		Harp Seal		Minke Whale	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
2019	13	0.51	0	0	0	0	20	0.56	0	0	0	0	17	0.35	18	0.4	29	.84	0.2[a]	na
2020	16	0.63	0	0	0	0	30	0.55	0	0	0	0	9	0.43	9	0.72	2	1.01	0	0
2021	10	0.65	0	0	0	0	24	0.33	0	0	0	0	9	0.40	7	0.69	2	1.01	0	0
2022	12	0.66	0	0	0	0	26	0.57	0	0	0	0	5	0.38	8	0.81	2	1.01	0	0

Note: This table only includes observed bycatch. For a complete list of marine mammal species interactions with this fishery, please see https://www.fisheries.noaa.gov/national/marine-mammal-protection/mid-atlantic-gillnet-fishery-mmpa-list-fisheries. For bottlenose dolphin stocks not listed in this table (Northern Migratory Coastal Stock, Southern Migratory Coastal Stock, Northern NC Estuarine Stock, Southern NC Estuarine Stock), see Lyssikatos & Garrison 2018 and Lyssikatos 2021.

[a] Unextrapolated mortalities

na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

New England/North Atlantic Bottom Trawl

	Harbor Porpoise		Bottlenose Dolphin, Atlantic Offshore Stock		White-sided Dolphin		Common Dolphin		Risso's Dolphin, Atlantic		Pilot Whale, Unidentified		Long-finned Pilot Whale		Harbor Seal		Gray Seal		Harp Seal		Minke Whale	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	91	0.97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	110	0.97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	182	0.71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	142	0.77	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	93	1.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	137	0.34	27	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	161	0.34	30	0.3	0	0	21	0.27	0	0	0	0	0	0	49	1.1	0	0
2002	0	0	0	0	70	0.32	26	0.29	0	0	22	0.26	0	0	0	0	0	0	0	0	0	0
2003	*	*	0	0	216	0.27	26	0.29	0	0	20	0.26	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	200	0.30	26	0.29	0	0	15	0.29	0	0	0	0	0	0	0	0	0	0
2005	7.2	0.48	0	0	213	0.28	32	0.28	0	0	15	0.30	0	0	0	0	unk	unk	unk	unk	0	0
2006	6.5	0.49	0	0	40	0.50	25	0.28	0	0	14	0.28	0	0	0	0	0	0	0	0	0	0
2007	5.6	0.46	48	0.95	29	0.66	24	0.28	3	0.52	0	0	0	0	0	0	unk	unk	0	0	0	0
2008	5.6	0.97	19	0.88	13	0.57	6	0.99	2	0.56	0	0	21	0.51	0	0	16	0.52	0	0	2.9	0.73
2009	0	0	18	0.92	171	0.28	24	0.60	3	0.53	0	0	13	0.70	0	0	22	0.46	5	1.02	0	0
2010	0	0	4	0.53	37	0.32	114	0.32	2	0.55	0	0	30	0.43	0	0	30	0.34	0	0	0	0
2011	5.9	0.71	10	0.84	141	0.24	72	0.37	3	0.55	0	0	55	0.18	9	0.58	58	0.25	3	1.02	0	0
2012	0	0	0	0	27	0.47	40	0.54	0	0	0	0	33	0.32	3	1	37	0.49	0	0	0	0
2013	7	0.98	0	0	33	0.31	17	0.54	0	0	0	0	16	0.42	4	0.89	20	0.37	0	0	0	0
2014	5.5	0.86	0	0	16	0.5	17	0.53	4.2	0.91	0	0	32	0.44	11	0.63	19	0.45	0	0	0	0
2015	3.7	0.49	19	0.65	15	0.52	22	0.45	0	0	0	0	0	0	0	0	23	0.46	0	0	0	0
2016	0	0	33.5	0.89	28	0.46	16	0.46	17	0.88	0	0	29	0.58	0	0	0	0	0	0	0	0
2017	0	0	0	0	15	0.64	0	0	0	0	0	0	0	0	8.3	0	16	0.24	0	0	0	0
2018	0	0	0	0	0	0	28	0.54	0	0	0	0	0	0	0	0	32	0.42	0	0	0	0
2019	10.8	0.63	5.6	0.92	79	0.28	10	0.62	0	0	0	0	5	0.881	5.4	0.88	30	0.37	5.4	0.89	0	0
2020	3.6	0.63	1.9	0.92	31	0.26	50	0.25	0	0	0	0	2	0.88	4.6	0.68	25.8	0.26	1.8	0.89	0	0
2021	5.0	0.92	3.7	0.86	15	0.52	43	0.42	3.8	0.88	0	0	8	0	0	0	7	0.60	0	0	0	0
2022	3.0	0.56	5	0.32	13	0.4	17	0.30	0	0	0	0	10	0.54	7	0.39	25	0.22	0	0	0	0

Note: This table only includes observed bycatch. For a complete list of marine mammal species interactions with this fishery, please see https://www.fisheries.noaa.gov/national/marine-mammal-protection/northeast-bottom-trawl-fishery-mmpa-list-fisheries

na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

[a] Unextrapolated mortalities

Mid-Atlantic Bottom Trawl

	Bottlenose Dolphin, Atlantic Offshore Stock		White-sided Dolphin		Common Dolphin		Risso's Dolphin, Atlantic		Pilot Whale, Unidentified		Harbor Seal		Gray Seal	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
1997	0	0	161	1.58	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	228	1.03	0	0	0	0
2000	0	0	27	0.17	0	0	0	0	0	0	0	0	0	0
2001	0	0	27	0.19	103	0.27	0	0	39	0.3	0	0	0	0
2002	0	0	25	0.17	87	0.27	0	0	38	0.36	0	0	0	0
2003	0	0	31	0.25	99	0.28	0	0	31	0.31	0	0	0	0
2004	0	0	26	0.2	159	0.3	0	0	35	0.33	0	0	0	0
2005	0	0	38	0.29	141	0.29	0	0	31	0.31	0	0	0	0
2006	0	0	3	0.53	131	0.28	0	0	37	0.34	0	0	0	0
2007	11	0.42	2	1.03	66	0.27	33	0.34	0	0	0	0	0	0
2008	16	0.36	0	0	23	1	39	0.69	0	0	0	0	0	0
2009	21	0.45	0	0	167	0.46	23	0.5	0	0	24	0.92	38	0.7
2010	20	0.34	0	0	21	0.96	54	0.74	0	0	11	1.1	0	0
2011	34	0.31	0	0	271	0.25	62	0.56	0	0	0	0	25	0.57
2012	16	1.00	0	0	323	0.26	8	1	0	0	23	1	30	1.1
2013	0	0	0	0	269	0.29	42	0.71	0	0	11	0.96	29	0.67
2014	25	0.66	9.7	0.94	329	0.29	21	0.93	0	0	10	0.95	7	0.96
2015	0	0	0	0	250	0.32	40	0.63	0	0	7.4	1.0	0	0
2016	7.3	0.93	0	0	177	0.33	39	0.56	0	0	0	0	26	0.57
2017	22.1	0.66	0	0	380	0.23	43	0.51	0	0	0	0	26	0.40
2018	6.33	0.91	0	0	205	0.21	0	0	0	0	5.6	0.94	56	0.58
2019	0	0	0	0	395	0.23	0	0	0	0	7.3	0.93	22	0.53
2020	9.5	0.55	0	0	333	0.14	18.4	0.51	0	0	4.3	0.67	34.7	0.35
2021	38	1.03	0	0	230	0.57	0	0	0	0	0	0	0	0
2022	11	0.87	0	0	293	0.27	45	0.63	0	0	0	0	64	0.37

Note: This table only includes observed bycatch. For a complete list of marine mammal species interactions with this fishery, please see https://www.fisheries.noaa.gov/national/marine-mammal-protection/mid-atlantic-bottom-trawl-fishery-mmpa-list-fisheries

na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

Northeast Mid-Water Trawl

	White-sided Dolphin		Common Dolphin		Pilot Whale, Unidentified		Long-finned Pilot Whale		Harbor Seal		Gray Seal	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
1999	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	4.6	0.74	0	0	0	0	0	0
2001	unk	na	0	0	11	0.74	0	0	0	0	0	0
2002	unk	na	0	0	8.9	0.74	0	0	0	0	0	0
2003	22	0.97	0	0	14	0.56	0	0	0	0	0	0
2004	0	0	0	0	5.8	0.58	0	0	0	0	0	0
2005	9.4	1.03	0	0	1.1	0.68	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	16	0.61	0	0	0	0
2009	0	0	0	0	0	0	0	0	1.3	0.81	0	0
2010	0	0	1[a]	na	0	0	0	0	2[a]	na	0	0
2011	0	0	0	0	0	0	1	0	0	0	0	0
2012	0	0	1[a]	na	0	0	1	0	1[a]	na	1[a]	na
2013	0	0	0	0	0	0	3	0	0	0	1[a]	na
2014	0	0	0	0	0	0	4	na	1[a]	na	0	0
2015	0	0	0	0	0	0	0	na	2[a]	na	0	0
2016	0	0	0	0	0	0	3	na	1[a]	na	0	0
2017	0	0	0	0	0	0	0	na	0	na	0	0
2018	0	0	0	0	0	0	0	0	0	0	1[a]	na
2019	0	0	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0	0	0	0

Note: This table only includes observed bycatch. For a complete list of marine mammal species interactions with this fishery, please see https://www.fisheries.noaa.gov/national/marine-mammal-protection/northeast-mid-water-trawl-fishery-mmpa-list-fisheries

[a] Unextrapolated mortalities

na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

Mid-Atlantic Mid-Water Trawl

	White-sided Dolphin		Common Dolphin		Risso's Dolphin, Atlantic		Harbor Seal		Gray Seal	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
1999	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0
2001	unk	na	0	0	0	0	0	0	0	0
2002	unk	na	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0
2004	22	0.99	0	0	0	0	0	0	0	0
2005	58	1.02	0	0	0	0	0	0	0	0
2006	29	0.74	0	0	0	0	0	0	0	0
2007	12	0.98	3.2	0.7	0	0	0	0	0	0
2008	15	0.73	0	0	1[a]	na	0	0	0	0
2009	4	0.92	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	1[a]	na	1[a]	na
2011	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0	0	0

Note: This table only includes observed bycatch. For a complete list of marine mammal species interactions with this fishery, please see https://www.fisheries.noaa.gov/national/marine-mammal-protection/mid-atlantic-mid-water-trawl-includes-pair-trawl-fishery-mmpa

[a] Unextrapolated mortalities

na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

Pelagic Longline

	Pantropical Spotted Dolphin, GMex		Bottlenose Dolphin, Atlantic Offshore Stock		Common Dolphin		Risso's Dolphin, Atlantic		Risso's Dolphin, Gmex		Pilot Whale, Unidentified & Long-finned, Atlantic		Short-finned Pilot Whale, Atlantic		Beaked Whale, Unidentified	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
1992	0	0	0	0	0	0	0	0	0	0	22	0.23	0	0	0	0
1993	0	0	0	0	0	0	13	0.19	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	7	1	0	0	137	0.44	0	0	0	0
1995	0	0	0	0	0	0	103	0.68	0	0	345	0.51	0	0	0	0
1996	0	0	0	0	0	0	99	1	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	57	1	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	22	1	0	0	381	0.79	0	0	0	0
2000	0	0	0	0	0	0	64	1	0	0	133	0.88	0	0	0	0
2001	0	0	0	0	0	0	69	0.57	0	0	79	0.48	0	0	0	0
2002	0	0	0	0	0	0	28	0.86	0	0	54	0.46	0	0	0	0
2003	0	0	0	0	0	0	40	0.63	0	0	21	0.77	0	0	5.3	1
2004	0	0	0	0	0	0	28	0.72	0	0	74	0.42	0	0	0	0
2005	0	0	0	0	0	0	3	1	0	0	212	0.21	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	185	0.47	0	0	0	0
2007	0	0	0	0	0	0	9	0.65	0	0	57	0.65	0	0	0	0
2008	0	0	0	0	0	0	16.8	0.73	8.3	0.63	0	0	80	0.42	0	0
2009	16	0.69	8.8	1	8.5	1	11.8	0.711	0	0	0	0	17	0.7	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0	127	0.78	0	0
2011	0	0	0	0	0	0	12	0.70	1.5	1	0	0	305	0.29	0	0
2012	0	0	62	0.68	0	0	15	1	30	1	0	0	170.1	0.33	0	0
2013	2.1	1	0	0	0	0	1.9	1	15	1	0	0	124	0.32	0	0
2014	0	0	0	0	0	0	7.7	1	0	0	9.6	0.43	233	0.24	0	0
2015	0	0	0	0	9.05	1	8.4	0.71	0	0	2.2	0.49	200	0.24	0	0
2016	0	0	0	0	0	0	16	0.57	0	0	1.1	0.6	111	0.31	0	0
2017	0	0	0	0	4.92	1	0.2	1	0	0	3.3	0.98	133	0.29	0	0
2018	0	0	17.3	0.73	1.44	1	0.2	0.94	0	0	0.4	0.93	102	0.39	0	0
2019	12.9	1	0	0	0	0	0	0	0	0	0.4	1	131	0.37	0.3	1
2020	1	1	10.2	0.73	0	0	12.2	0.71	0	0	5.7	0.44	371	0.45	0	0
2021	0	0	15.8	1.00	0	0	0	0	0	0	2.8	0.66	355	0.31	0	0

	Pantropical Spotted Dolphin, GMex		Bottlenose Dolphin, Atlantic Offshore Stock		Common Dolphin		Risso's Dolphin, Atlantic		Risso's Dolphin, Gmex		Pilot Whale, Unidentified & Long-finned, Atlantic		Short-finned Pilot Whale, Atlantic		Beaked Whale, Unidentified	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
2022	1.4	1	5	1	0	0	0	0	0	0	0.4	1.04	142	0.29	0	0

na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

Pelagic Drift Gillnet

	White-sided Dolphin		Common Dolphin		Risso's Dolphin, Atlantic		Pilot Whale, Unidentified		Long-finned Pilot Whale		Bottlenose Dolphin, Atlantic Offshore Stock		Beaked Whale, Unidentified		Sowerby's Beaked Whales		Harbor Porpoise	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
1989	4.4	0.71	0	0	87	0.52	0	0	0	0	72	0.18	60	0.21	0	0	0.7	7
1990	6.8	0.71	0	0	144	0.46	0	0	0	0	115	0.18	76	0.26	0	0	1.7	2.65
1991	0.9	0.71	223	0.12	21	0.55	30	0.26	0	0	26	0.15	13	0.21	0	0	0.7	1
1992	0.8	0.71	227	0.09	31	0.27	33	0.16	0	0	28	0.1	9.7	0.24	0	0	0.4	1
1993	2.7	0.17	238	0.08	14	0.42	31	0.19	0	0	22	0.13	12	0.16	0	0	1.5	0.34
1994	0	0.71	163	0.02	1.5	0.16	20	0.06	0	0	14	0.04	0	0	3	0.09	0	0
1995	0	0	83	0	6	0	9.1	0	0	0	5	0	3	0	6	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	2	0.25	9	0.12	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	9	0	0	0	0	0	3	0	7	0	2	0	0	0
1999	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0

Note: This table only includes observed bycatch.

Pelagic Pair Trawl

	White-sided Dolphin		Common Dolphin		Risso's Dolphin, Atlantic		Pilot Whale, Unidentified		Long-finned Pilot Whale		Bottlenose Dolphin, Atlantic Offshore	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
1989	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0.6	1	0	0	0	0	13	0.52
1992	0	0	0	0	4.3	0.76	0	0	0	0	73	0.49
1993	0	0	0	0	3.2	1	0	0	0	0	85	0.41
1994	0	0	0	0	0	0	2	0.49	0	0	4	0.4
1995	0	0	0	0	3.7	0.45	22	0.33	0	0	17	0.26
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0	0	0

Note: This table only includes observed bycatch.
na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

Gulf of America Shrimp Otter Trawl

	Atlantic Spotted Dolphin		Bottlenose Dolphin, Continental Shelf Stock		Bottlenose Dolphin, Western Coastal Stock		Bottlenose Dolphin, Northern Coastal Stock		Bottlenose Dolphin, Eastern Coastal Stock		Bottlenose Dolphin, TX BSE Stocks		Bottlenose Dolphin, LA BSE Stocks		Bottlenose Dolphin, AL/MS BSE Stocks		Bottlenose Dolphin, FL BSE Stocks	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
1997	128	0.44	172	0.42	217	0.84	13	0.80	18	0.99	0	-	29	1.00	37	0.82	3	0.99
1998	146	0.44	180	0.43	148	0.80	20	0.95	23	0.99	0	-	31	0.99	37	0.83	2	0.99
1999	120	0.44	159	0.42	289	0.91	31	0.72	11	0.99	0	-	38	0.89	52	0.85	3	0.99
2000	105	0.44	156	0.43	242	0.86	15	0.72	15	0.99	0	-	21	0.86	47	0.77	8	0.99
2001	115	0.45	169	0.42	291	0.85	15	0.79	11	0.99	0	-	28	0.99	55	0.74	6	0.99
2002	128	0.44	166	0.42	223	0.80	29	0.84	12	0.99	0	-	118	0.98	69	0.84	6	0.99
2003	75	0.45	122	0.43	133	0.79	15	0.71	5	0.99	0	-	72	1.00	52	0.82	5	0.99
2004	84	0.46	132	0.43	111	0.80	14	0.88	5	0.99	0	-	77	0.90	26	0.90	2	0.99
2005	55	0.49	94	0.43	66	0.84	11	0.64	1	0.99	0	-	57	0.96	15	0.72	3	0.99
2006	49	0.44	77	0.43	105	0.89	16	0.67	6	0.99	0	-	55	0.97	17	0.64	3	0.99
2007	43	0.45	60	0.43	81	0.85	20	0.67	3	0.99	0	-	47	0.90	26	0.77	1	0.99
2008	37	0.53	46	0.44	56	0.80	22	0.77	1	0.99	0	-	61	1.00	28	0.76	1	0.99
2009	49	0.50	56	0.43	77	0.89	35	0.67	3	0.99	0	-	116	1.02	45	0.73	6	0.99
2010	44	0.42	57	0.40	57	0.83	17	0.64	3	0.99	0	-	113	1.09	58	0.64	6	0.99
2011	35	0.48	63	0.44	67	0.91	13	0.65	1	0.99	0	-	104	0.98	47	0.64	3	0.99
2012	28	0.44	49	0.37	48	0.79	12	0.68	0.6	1.01	0	-	31	0.76	12	0.80	0.2	1.01
2013	27	0.43	57	0.38	23	0.74	6.0	0.83	0.7	1.01	0	-	19	0.74	14	0.95	1.1	1.01
2014	23	0.43	58	0.40	57	0.84	8.3	0.74	1.1	0.98	0	-	40	0.94	2.8	0.66	1.2	0.98
2015	24	0.39	62	0.34	18	0.55	4.5	0.57	4.1	1.00	0.3	1.01	32	0.64	20	0.67	0.1	1.00
2016	43	0.41	70	0.33	46	0.47	7.2	0.56	8.1	1.00	1.1	1.00	53	0.63	46	0.63	1.7	1.00
2017	46	0.40	72	0.30	46	0.48	5.4	0.55	9.8	1.00	0.6	1.00	63	0.52	29	0.57	0.9	1.00
2018	36	0.40	64	0.30	33	0.47	5.6	0.55	8.7	0.98	0.1	0.99	45	0.53	35	0.62	0.2	0.98
2019	29	0.38	50	0.33	17	0.47	9.9	0.55	7.2	0.98	0.1	1.02	34	0.61	33	0.63	0.5	0.98

Note: This table only includes observed bycatch. For a complete list of marine mammal species interactions with this fishery, please see https://www.fisheries.noaa.gov/national/marine-mammal-protection/southeastern-us-atlantic-gulf-mexico-shrimp-trawl-fishery-mmpa.
na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

Appendix V: Fishery Bycatch Summaries

Part B: By Species

Harbor Porpoise

	Mid-Atlantic Gillnet		North Atlantic Bottom Trawl		NE Sink Gillnet		Pelagic Drift Gillnet	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
	na	na	0	0	2900	0.32	1.7	2.65
	na	na	0	0	1200	0.21	0.4	1
	na	na	0	0	2100	0.18		
	572	0.35	0	0	782	0.22		
	53	0.49	0	0	270	0.28		
	26	0.95	0	0	53	0.97		
	76	1.13	*	*	592	0.33		
	470	0.51	7.2	0.48	630	0.23		
2008	350	0.75	5.6	0.97	666	0.48		
2010	259	0.88	0	0	387	0.27		
2011	123	0.41	5.9	0.71	273	0.2		
2012	63.41	0.83	0	0	277.3	0.59		
2015	60	1.16	3.7	0.49	177	0.28		
	23	0.64	0	0	125	0.34		
	12	0.66	3	0.56	118	0.22		

Note: This table only includes observed bycatch.

na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

Common Bottlenose Dolphin, Atlantic Offshore Stock

	Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		North Atlantic Bottom Trawl		NE Sink Gillnet		Pelagic Drift Gillnet		Pelagic Longline	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
1991	na	na	na	na	91	0.97	0	0	26	0.15	0	0
1992	na	na	na	na	0	0	0	0	28	0.1	0	0
1993	na	na	na	na	0	0	0	0	22	0.13	0	0
1994	na	na	na	na	0	0	0	0	14	0.04	0	0
1995	na	na	56	1.66	0	0	0	0	5	0	0	0
1996	na	na	64	0.83	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0			0	0
1998	0	0	63	0.94	0	0	0	0			0	0
1999	0	0	0	0	0	0	0	0			0	0
2000	0	0	0	0	0	0	132	1.16			0	0
2001	0	0	na	na	0	0	0	0			0	0
2002	0	0	0	0	0	0	0	0			0	0
2003	0	0	0	0	0	0	0	0			0	0
2004	0	0	0	0	0	0	1[a]	na			0	0
2005	0	0	1[a]	na	0	0	0	0			0	0
2006	0	0	0	0	0	0	0	0			0	0
2007	11	0.42	0	0	48	0.95	0	0			0	0
2008	16	0.36	0	0	19	0.88	0	0			0	0
2009	21	0.45	0	0	18	0.92	0	0			8.8	1
2010	20	0.34	0	0	4	0.53	0	0			0	0
2011	34	0.31	0	0	10	0.84	0	0			0	0
2012	16	1	0	0	0	0	0	0			61.8	0.68
2013	0	0	0	0	0	0	26	0.95			0	0
2014	25	0.66	0	0	0	0	0	0			0	0
2015	0	0	0	0	18.6	0.65	0	0			0	0
2016	7.3	0.93	0	0	33.5	0.89	0	0			0	0
2017	22.1	0.66	0	0	0	0	8	0.92			0	0
2018	6.3	0.91	0	0	0	0	0	0			17.3	0.73
2019	0	0	0	0	5.6	0.92	0	0			0	0
2020	9.5	0.55	0	0	1.9	0.92	2	0.99			10.2	0.73
2021	38	1.03	0	0	3.7	0.86	1.4	0.99			15.8	1.00
2022	11	0.87	0	0	5	0.32	0	0			5	1

Note: This table only includes observed bycatch.

[a] Unextrapolated mortalities

na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

White-sided Dolphin

	Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		Mid-Atlantic Midwater Trawl		North Atlantic Bottom Trawl		NE Sink Gillnet		Northeast Midwater Trawl		Pelagic Drift Gillnet	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
1990	na	na	na	na	na	na	0	0	0	0	na	na		
1991	na	na	na	na	na	na	0	0	49	0.46	na	na	0	0
1992	na	na	na	na	na	na	110	0.97	154	0.35	na	na	110	0.97
1993	na	na	na	na	na	na	0	0	205	0.31	na	na	0	0
1994	na	na	0	0	na	na	182	0.71	240	0.51	na	na	182	0.71
1995	na	na	0	0	na	na	0	0	80	1.16	na	na	0	0
1996	na	na	0	0	na	na	0	0	114	0.61	na	na		
1997	161	1.58	45	0.82	na	na	0	0	140	0.61	na	na		
1998	0	0	0	0	na	na	0	0	34	0.92	na	na		
1999	0	0	0	0	0	0	0	0	69	0.7	0	0		
2000	27	0.17	0	0	0	0	137	0.34	26	1	0	0		
2001	27	0.19	0	0	unk	na	161	0.34	26	1	unk	na		
2002	25	0.17	0	0	unk	na	70	0.32	30	0.74	unk	na		
2003	31	0.25	0	0	0	0	216	0.27	31	0.93	22	0.97		
2004	26	0.2	0	0	22	0.99	200	0.3	7	0.98	0	0		
2005	38	0.29	0	0	58	1.02	213	0.28	59	0.49	9.4	1.03		
2006	3	0.53	0	0	29	0.74	40	0.5	41	0.71	0	0		
2007	2	1.03	0	0	12	0.98	29	0.66	0	0	0	0		
2008	0	0	0	0	15	0.73	13	0.57	81	0.57	0	0		
2009	0	0	0	0	4	0.92	171	0.28	0	0	0	0		
2010	0	0	0	0	0	0	37	0.32	66	0.9	0	0		
2011	0	0	0	0	0	0	141	0.24	18	0.43	0	0		
2012	0	0	0	0	0	0	27	0.47	9	0.92	0	0		
2013	0	0	0	0	0	0	33	0.31	4	1.03	0	0		
2014	9.7	0.94	0	0	0	0	16	0.50	10	0.66	0	0		
2015	0	0	0	0	0	0	15	0.52	0	0	0	0		
2016	0	0	0	0	0	0	28	0.46	0	0	0	0		
2017	0	0	0	0	0	0	15	0.64	0	0	0	0		
2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	79	0.28	0	0	0	0	0	0
2020	0	0	0	0	0	0	31	0.26	2	na	0	0		

	Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		Mid-Atlantic Midwater Trawl		North Atlantic Bottom Trawl		NE Sink Gillnet		Northeast Midwater Trawl		Pelagic Drift Gillnet	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
2021	0	0	0	0	0	0	15	0.52	15	0.52	0	0	0	0
2022	0	0	0	0	0	0	13	0.40	2	0.43	0	0		

Note: This table only includes observed bycatch.

na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

Risso's Dolphin, Western North Atlantic Stock

	Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		North Atlantic Bottom Trawl		NE Sink Gillnet		Pelagic Longline	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
1996	0	0	0	0	0	0	0	0	99	1
1997	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	57	1
1999	0	0	0	0	0	0	0	0	22	1
2000	0	0	0	0	0	0	15	1.06	64	1
2001	0	0	0	0	0	0	0	0	69	0.57
2002	0	0	0	0	0	0	0	0	28	0.86
2003	0	0	0	0	0	0	0	0	40	0.63
2004	0	0	0	0	0	0	0	0	28	0.72
2005	0	0	0	0	0	0	15	0.93	3	1
2006	0	0	0	0	0	0	0	0	0	0
2007	33	0.34	34	0.73	3	0.52	0	0	9	0.65
2008	39	0.69	0	0	2	0.56	0	0	16.8	0.732
2009	23	0.5	0	0	3	0.53	0	0	11.8	0.711
2010	54	0.74	0	0	2	0.55	0	0	0	0
2011	62	0.56	0	0	3	0.55	0	0	11.8	0.699
2012	8	1	0	0	0	0	6	0.87	15.1	1
2013	42	0.71	0	0	0	0	23	0.97	1.9	1
2014	21	0.93	0	0	4.2	0.91	0	0	7.7	1.0
2015	40	0.63	0	0	0	0	0	0	8.4	0.71
2016	39	0.56	0	0	17	0.88	0	0	16.1	0.57
2017	31	0.51	0	0	0	0	0	0	0.2	1
2018	0	0	0	0	0	0	0	0	0.2	0.94
2019	0	0	0	0	0	0	5.3	0.7	0	0
2020	18.4	0.51	0	0	0	0	2	1.01	12.2	0.7
2021	0	0	0	0	3.8	.88	3	0	0	0
2022	45	0.63	0	0	0	0	4	.64	0	0

Note: This table only includes observed bycatch.
na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

Long-finned Pilot Whale, Western North Atlantic Stock

	Mid-Atlantic Bottom Trawl		Mid-Atlantic Midwater Trawl		North Atlantic Bottom Trawl		NE Sink Gillnet		Northeast Midwater Trawl		Pelagic Longline	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
2008	0	0	0	0	21	0.51	0	0	16	0.61	na	na
2009	0	0	0	0	13	0.7	0	0	0	0	na	na
2010	0	0	0	0	30	0.43	3	0.82	0	0	na	na
2011	0	0	0	0	55	0.18	0	0	1	0	na	na
2012	0	0	0	0	33	0.32	0	0	1	0	na	na
2013	0	0	0	0	16	0.42	0	0	3	0	na	na
2014	0	0	0	0	32	0.44	0	0	4	na	9.6	0.43
2015	0	0	0	0	0	0	0	0	0	na	2.2	0.49
2016	0	0	0	0	29	0.58	0	0	3	na	1.1	0.6
2017	0	0	0	0	0	0	0	0	0	na	3.3	0.98
2018	0	0	0	0	0	0	0	0	0	0	0.4	0.93
2019	0	0	0	0	5.4	0.88	0	0	0	0	0.4	1
2020	0	0	0	0	1.8	0.88	0	0	0	0	5.7	0.44
2021	0	0	0	0	8	0.62	0	0	0	0	2.8	0.66
2022	0	0			10	0.54	0	0			0.4	1.04

Note: This table only includes observed bycatch.

na = not applicable; unk = observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd = to be determined

Short-finned Pilot Whale, Western North Atlantic Stock

	Pelagic Longline	
Year	**M/SI (est)**	**CV**
2008	80	0.42
2009	17	0.7
2010	127	0.78
2011	305	0.29
2012	170	0.33
2013	124	0.32
2014	233	0.24
2015	200	0.24
2016	111	0.31
2017	133	0.29
2018	102	0.39
2019	131	0.37
2020	371	0.45
2021	355	0.31
2022	142	0.29

Note: This table only includes observed bycatch.
na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

Common Dolphin, Western North Atlantic Stock

	Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		North Atlantic Bottom Trawl		NE Sink Gillnet		Northeast Midwater Trawl		Pelagic Drift Gillnet		Pelagic Longline	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
1990	na	na	na	na	0	0	0	0	na	na			na	na
1991	na	na	na	na	0	0	0	0	na	na	223	0.12	na	na
1992	na	na	na	na	0	0	0	0	na	na	227	0.09	0	0
1993	na	na	na	na	0	0	0	0	na	na	238	0.08	0	0
1994	na	na	0	0	0	0	0	0	na	na	163	0.02	0	0
1995	na	na	7.4	0.69	142	0.77	0	0	na	na	83	0	0	0
1996	na	na	43	0.79	0	0	63	1.39	na	na			0	0
1997	0	0	0	0	93	1.06	0	0	na	na			0	0
1998	0	0	0	0	0	0	0	0	na	na			0	0
1999	0	0	0	0	0	0	146	0.97	0	0			0	0
2000	0	0	0	0	27	0.29	0	0	0	0			0	0
2001	103	0.27	0	0	30	0.3	0	0	0	0			0	0
2002	87	0.27	0	0	26	0.29	0	0	0	0			0	0
2003	99	0.28	0	0	26	0.29	0	0	0	0			0	0
2004	159	0.3	0	0	26	0.29	0	0	0	0			0	0
2005	141	0.29	0	0	32	0.28	5	0.8	0	0			0	0
2006	131	0.28	0	0	25	0.28	20	1.05	0	0			0	0
2007	66	0.27	0	0	24	0.28	11	0.94	0	0			0	0
2008	23	1	0	0	6	0.99	34	0.77	0	0			0	0
2009	167	0.46	0	0	24	0.6	43	0.77	0	0			8.8	1
2010	21	0.96	30	0.48	114	0.32	42	0.81	1[a]	na			0	0
2011	271	0.25	29	0.53	72	0.37	64	0.71	0	0			0	0
2012	323	0.26	15	0.93	40	0.54	95	0.4	1[a]	0			61.8	.68
2013	269	0.29	62	0.67	17	0.54	104	0.46	0	0			0	0
2014	17	0.53	17	0.86	17	0.53	111	0.47	0	0			0	0
2015	250	0.32	30	0.55	22	0.45	55	0.54	0	0			9.1	1.0
2016	177	0.33	7	0.97	16	0.46	80	0.38	0	0			0	0
2017	380	0.23	22	0.71	0	0	133	0.28	0	0			4.92	1
2018	205	0.54	98	0.91	28	0.54	93	0.45	0	0			1.44	1
2019	395	0.23	20	0.56	10	0.62	5	0.68	0	0			0	0
2020	333	0.14	30	0.55	13	0.43	50	0.25	0	0			0	0

	Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		North Atlantic Bottom Trawl		NE Sink Gillnet		Northeast Midwater Trawl		Pelagic Drift Gillnet		Pelagic Longline	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
2021	230	0.57	24	0.33	43	0.42	39	0.24	0	0			0	0
2022	293	0.27	26	0.57	17	0.30	22	0.36					0	0

Note: This table only includes observed bycatch.
[a] Unextrapolated mortalities
na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

Harbor Seal

	Herring Purse Seine		Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		Mid-Atlantic Midwater Trawl		Northeast Bottom Trawl		NE Sink Gillnet		Northeast Midwater Trawl	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
1990	na	na	na	na	na	na	na	na	0	0	602	0.68	na	na
1991	na	na	na	na	na	na	na	na	0	0	231	0.22	na	na
1992	na	na	na	na	na	na	na	na	0	0	373	0.23	na	na
1993	na	na	na	na	na	na	na	na	0	0	698	0.19	na	na
1994	na	na	na	na	na	na	na	na	0	0	1330	0.25	na	na
1995	na	na	na	na	0	0	na	na	0	0	1179	0.21	na	na
1996	na	na	na	na	0	0	na	na	0	0	911	0.27	na	na
1997	na	na	0	0	0	0	na	na	0	0	598	0.26	na	na
1998	na	na	0	0	11	0.77	na	na	0	0	332	0.33	na	na
1999	na	na	0	0	0	0	na	na	0	0	1446	0.34	0	0
2000	na	na	0	0	0	0	0	0	0	0	917	0.43	0	0
2001	na	na	0	0	0	0	0	0	0	0	1471	0.38	0	0
2002	na	na	0	0	0	0	0	0	0	0	787	0.32	0	0
2003	0	0	0	0	0	0	0	0	0	0	542	0.28	0	0
2004	0	0	0	0	15	0.86	0	0	0	0	792	0.34	0	0
2005	0	0	0	0	63	0.67	0	0	0	0	719	0.2	0	0
2006	na	na	0	0	26	0.98	0	0	0	0	87	0.58	0	0
2007	0	0	0	0	0	0	0	0	0	0	92	0.49	0	0
2008	0	0	0	0	88	0.74	0	0	0	0	242	0.41	0	0
2009	0	0	24	0.92	47	0.68	0	0	0	0	513	0.28	1.3	0.81
2010	0	0	11	1.1	89	0.39	1[a]	0	0	0	540	0.25	2	0
2011	1[a]	0	0	0	21	0.67	0	0	9	0.58	343	0.19	0	0
2012	0	0	23	1	0	0	0	0	3	1	252	0.26	1	0
2013	0	0	11	0.96	0	0	0	0	4	0.89	147	0.3	0	0
2014	0	0	10	0.95	19	1.06	0	0	11	0.63	390	0.39	na	ma
2015	0	0	7.4	1.0	48	0.52	0	0	0	0	474	0.17	2[a]	na
2016	0	0	0	0	18	0.95	0	0	0	0	245	0.29	1[a]	na
2017	0	0	0	0	3	0.62	0	0	0	0	298	0.18	0	0
2018	0	0	6	0.94	26	0.52	0	0	0	0	188	0.36	0	0
2019	0	0	7	0.93	17	0.35	0	0	5.4	0.88	316	0.15	0	0
2020	0	0	4.3	0.67	9	0.43	0	0	4.6	0.68	261	0.14	0	0

	Herring Purse Seine		Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		Mid-Atlantic Midwater Trawl		Northeast Bottom Trawl		NE Sink Gillnet		Northeast Midwater Trawl	
Year	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**	**M/SI (est)**	**CV**
2021	0	0	0	0	9	0.40	0	0	0	0	241	0.13	0	0
2022					5	0.38					185	0.18		

Note: This table only includes observed bycatch.
[a] Unextrapolated mortalities
na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

Gray Seal

	Herring Purse Seine		Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		Mid-Atlantic Midwater Trawl		Northeast Bottom Trawl		NE Sink Gillnet		Northeast Midwater Trawl	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
1994	na	na	na	na	0	0	0	0	0	0	19	0.95	0	0
1995	na	na	na	na	0	0	0	0	0	0	117	0.42	0	0
1996	na	na	na	na	0	0	0	0	0	0	49	0.49	0	0
1997	na	na	0	0	0	0	0	0	0	0	131	0.5	0	0
1998	na	na	0	0	0	0	0	0	0	0	61	0.98	0	0
1999	na	na	0	0	0	0	0	0	0	0	155	0.51	0	0
2000	na	na	0	0	0	0	0	0	0	0	193	0.55	0	0
2001	na	na	0	0	0	0	0	0	0	0	117	0.59	0	0
2002	na	na	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	242	0.47	0	0
2004	0	0	0	0	69	0.92	0	0	0	0	504	0.34	0	0
2005	0	0	0	0	0	0	0	0	unk	unk	574	0.44	0	0
2006	na	na	0	0	0	0	0	0	0	0	248	0.47	0	0
2007	0	0	0	0	0	0	0	0	unk	unk	886	0.24	0	0
2008	0	0	0	0	0	0	0	0	16	0.52	618	0.23	0	0
2009	0	0	38	0.7	0	0	0	0	22	0.46	1063	0.26	0	0
2010	0	0	0	0	267	0.75	1[a]	0	30	0.34	1155	0.28	0	0
2011	0	0	25	0.57	19	0.6	0	0	58	0.25	1491	0.22	0	0
2012	0	0	30	1.1	14	0.98	0	0	37	0.49	542	0.19	1[a]	na
2013	0	0	29	0.67	0	0	0	0	20	0.37	1127	0.2	1[a]	na
2014	0	0	7	0.96	22	1.09	0	0	19	0.45	917	0.14	0	0
2015	0	0	0	0	15	1.04	0	0	23	0.46	1021	0.25	0	0

	Herring Purse Seine		Mid-Atlantic Bottom Trawl		Mid-Atlantic Gillnet		Mid-Atlantic Midwater Trawl		Northeast Bottom Trawl		NE Sink Gillnet		Northeast Midwater Trawl	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
2016	0	0	26	0.57	7	0.93	0	0	0	0	498	0.33	0	0
2017	0	0	26	0.40	22	1.09	0	0	16	0.24	930	0.16	0	0
2018	0	0	56	0.58	15	1.04	0	0	32	0.42	1113	0.32	1[a]	na
2019	0	0	22	0.53	7	0.93	0	0	30	0.37	2014	0.17	0	0
2020	0	0	34.7	.35	9.3	0.72	0	0	25.8	0.26	1357	0.14	0	0
2021	0	0	0	0	7	0.69	0	0	7.5	.60	1027	0.14	0	0
2022	0	0	3	0.56	8	0.81	0	0	25	0.22	522	0.12	0	0

Note: This table only includes observed bycatch.

[a] Unextrapolated mortalities

na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

Harp Seal

	Mid-Atlantic Gillnet		Northeast Bottom Trawl		NE Sink Gillnet	
Year	**M/SI**	**CV**	**M/SI**	**CV**	**M/SI**	**CV**
1994	0	0	0	0	861	0.58
1995	0	0	0	0	694	0.27
1996	0	0	0	0	89	0.55
1997	0	0	0	0	269	0.5
1998	17	1.02	0	0	78	0.48
1999	0	0	0	0	81	0.78
2000	0	0	0	0	24	1.57
2001	0	0	49	1.1	26	1.04
2002	0	0	0	0	0	0
2003	0	0	*	*	0	0
2004	0	0	0	0	303	0.3
2005	0	0	0	0	35	0.68
2006	0	0	0	0	65	0.66
2007	38	0.9	0	0	119	0.35
2008	176	0.74	0	0	238	0.38
2009	0	0	5	1.02	415	0.27
2010	0	0	0	0	253	0.61
2011	0	0	3	1.02	14	0.46
2012	0	0	0	0	0	0
2013	0	0	0	0	22	0.75
2014	0	0	0	0	57	0.42
2015	0	0	0	0	119	0.34
2016	0	0	0	0	85	0.50
2017	0	0	0	0	44	0.37
2018	0	0	0	0	14	0.80
2019	29	0.84	5.4	0.89	163	0.19
2020	2	1.01	1.8	0.89	72	0.22
2021	2	1.01	0	0	66	0.24
2022	2	1.01			0	0

Note: This table only includes observed bycatch.
na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

Appendix VI: Estimates of Human-caused Mortality Resulting from the *Deepwater Horizon* Oil Spill

Estimates of human-caused mortality are a result of a population model developed to estimate the injury and time to recovery for stocks affected by the *Deepwater Horizon* (DWH) oil spill, taking into account long-term impacts resulting from mortality, reproductive failure, reduced survival rates, and the proportion of the stock exposed to DWH oil (DWH MMIQT 2015).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Beaked Whales[a]	15.96	13.49	11.42	9.68	8.21	6.28	4.81	3.68	2.79	2.09	1.52	1.05	0.65	0.31	0
Common Bottlenose Dolphin, Oceanic Stock	96.55	81.93	69.71	59.39	50.63	38.86	29.86	22.88	17.40	13.03	9.48	6.54	4.06	1.91	0
Rice's Whale	1.44	1.22	1.03	0.88	0.74	0.57	0.44	0.33	0.25	0.19	0.14	0.09	0.06	0.03	0
Clymene Dolphin	26.23	22.12	18.71	15.86	13.45	10.28	7.86	6.00	4.55	3.40	2.46	1.70	1.05	0.49	0
False Killer Whale	6.67	5.64	4.78	4.05	3.44	2.63	2.01	1.54	1.17	0.87	0.63	0.44	0.27	0.13	0
***Kogia* spp.**	111.92	91.48	75.08	61.80	50.98	37.92	28.27	21.04	15.56	11.33	8.03	5.40	3.27	1.50	0
Melon-headed Whale	29.33	24.83	21.04	17.84	15.13	11.56	8.85	6.76	5.13	3.83	2.78	1.92	1.19	0.56	0
Pantropical Spotted Dolphin	748.73	631.49	534.21	452.68	384.00	293.38	224.47	171.38	129.89	96.96	70.37	48.47	30.04	14.12	0
Pygmy Killer Whale	4.94	4.19	3.56	3.03	2.57	1.97	1.51	1.16	0.88	0.66	0.48	0.33	0.21	0.10	0
Risso's Dolphin	16.18	13.73	11.68	9.95	8.48	6.51	5.00	3.83	2.92	2.18	1.59	1.10	0.68	0.32	0
Rough-toothed Dolphin	113.72	96.50	82.11	69.96	59.64	45.78	35.18	26.96	20.50	15.35	11.17	7.72	4.79	2.26	0
Shelf Dolphins[b]	912.14	774.01	658.54	561.05	478.31	367.12	282.07	216.17	164.39	123.07	89.55	61.82	38.38	18.07	0
Short-finned Pilot Whale	10.79	9.13	7.73	6.56	5.56	4.25	3.25	2.49	1.88	1.41	1.02	0.71	0.44	0.21	0
Sperm Whale	29.82	25.12	21.20	17.90	15.14	11.53	8.79	6.70	5.07	3.78	2.74	1.89	1.17	0.55	0
Spinner Dolphin	352.31	297.15	251.37	213.01	180.70	138.05	105.63	80.65	61.13	45.63	33.12	22.82	14.14	6.65	0
Striped Dolphin	39.30	33.15	28.04	23.76	20.16	15.40	11.78	9.00	6.82	5.09	3.69	2.54	1.58	0.74	0

a. Beaked whales include Blainville's beaked whales, Gervais' beaked whales, and Cuvier's beaked whales

b. Shelf dolphins include common bottlenose dolphins and Atlantic spotted dolphins

DWH MMIQT [*Deepwater Horizon* Marine Mammal Injury Quantification Team]. 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.