NOAA Technical Memorandum NMFS-NE-241

# US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2016

US DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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## NOAA Technical Memorandum NMFS-NE-241

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# US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2016

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**Species Names:** The NEFSC Editorial Office's policy on the use of species names in all technical communications is generally to follow the American Fisheries Society's lists of scientific and common names for fishes, mollusks, and decapod crustaceans and to follow the Society for Marine Mammalogy's guidance on scientific and common names for marine mammals. Exceptions to this policy occur when there are subsequent compelling revisions in the classifications of species, resulting in changes in the names of species.

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**Editorial Treatment:** To distribute this report quickly, it has not undergone the normal technical and copy editing by the Northeast Fisheries Science Center's (NEFSC's) Editorial Office as have most other issues in the *NOAA Technical Memorandum NMFS-NE* series. Other than the covers and first two preliminary pages, all writing and editing have been performed by – and all credit for such writing and editing rightfully belongs to – those so listed on the title page.

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# 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 Mexico) 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 3 years for stocks determined to be non-strategic. Included in this report as appendices are: 1) a summary of serious injury/mortality estimates of marine mammals in observed U.S. fisheries (Appendix I), 2) a summary of NMFS records of large whale human-caused serious injury and mortality (Appendix II), 3) detailed fisheries information (Appendix III), 4) 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 a list of reports not updated in the current year (Appendix VI).

Table 1 contains a summary, by species, of the information included in the stock assessments, and also indicates those that have been revised since the 2015 publication. Most of the changes incorporate new information into sections on population size and/or mortality estimates. A total of 18 of the Atlantic and Gulf of Mexico stock assessment reports were revised for 2016. The revised SARs include 6 strategic and 12 non-strategic stocks.

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 2016 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.

# 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 to calculate it. The MMPA also requires that SARs be updated 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 Mexico) were published in July 1995 in the *NOAA Technical Memorandum* series (Blaylock *et al.* 1995). In April 1996, the 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 2015 SARs. In 1997 and 2004 SARs were not produced.

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 February 2017 date-stamp at the top right corner at the beginning of each report. Stocks not updated in 2016 are listed in Appendix VI.

**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, 211 pp.

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

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## Pinnipeds



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## Appendices

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

Total Annual S.I. (serious injury) and Mortality and Annual Fisheries S.I. and Mortality are mean annual figures for the period 2010-2014. The “SAR revised” column indicates 2016 stock assessment reports that have been revised relative to the 2015 reports (Y=yes, N=no). If abundance, mortality, PBR or status have been revised, they are indicated with the letters “a”, “m”, “p” and “status” respectively. For those species not updated in this edition, the year of last revision is indicated. Unk = unknown and undet=undetermined (PBR for species with outdated abundance estimates is considered "undetermined").

| Species | Stock Area | NMFS Ctr. | Nbest | Nbest CV | Nmin | Rmax | Fr | PBR | Total Annual S.I and Mort. | Annual Fish. S.I. and Mort. (cv) | Strategic Status | SAR Revised |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North Atlantic right whale | Western North Atlantic | NEC | 440 | 0 | 440 | 0.04[a] | 0.1 | 1 | 5.66[a] | 4.65[a] | Y | Y (a, m) |
| Humpback whale | Gulf of Maine | NEC | 823 | 0 | 823 | 0.065 | 0.5 | 13 | 9.05[b] | 7.25[b] | N | Y (m, p, status) |
| Fin whale | Western North Atlantic | NEC | 1,618 | 0.33 | 1,234 | 0.04 | 0.1 | 2.5 | 3.8[c] | 1.8[c] | Y | Y (m) |
| Sei whale | Nova Scotia | NEC | 357 | 0.52 | 236 | 0.04 | 0.1 | 0.5 | 0.8[d] | 0 [d] | Y | Y (m) |
| Minke whale | Canadian east coast | NEC | 2,591 | 0.81 | 1,425 | 0.04 | 0.5 | 14 | 8.25[e] | 6.45 [e] | N | Y (a, m, p) |
| Blue whale | Western North Atlantic | NEC | unk | unk | 440 | 0.04 | 0.1 | 0.9 | unk | unk | Y | N (2010) |
| Sperm whale | North Atlantic | NEC | 2,288 | 0.28 | 1,815 | 0.04 | 0.1 | 3.6 | 0.8 | 0.8 | Y | N (2014) |
| Dwarf sperm whale | Western North Atlantic | SEC | 3,785[j] | 0.47 [k] | 2,598 [j] | 0.04 | 0.4 | 21 | 3.5 | 3.5 (1.0) | N | Y (m, p) |
| Pygmy sperm whale | Western North Atlantic | SEC | 3,785 [j] | 0.47 [k] | 2,598 [j] | 0.04 | 0.4 | 21 | 3.5 | 3.5 (1.0) | N | Y (m, p) |
| Killer whale | Western North Atlantic | NEC | unk | unk | unk | 0.04 | 0.5 | unk | 0 | 0 | N | N (2014) |
| Pygmy killer whale | Western North Atlantic | SEC | unk | unk | unk | 0.04 | 0.5 | unk | 0 | 0 | N | N (2007) |
| False killer whale | Western North Atlantic | SEC | 442 | 1.06 | 212 | 0.04 | 0.5 | 2.1 | unk | unk | Y | N (2014) |
| Northern bottlenose whale | Western North Atlantic | NEC | unk | unk | unk | 0.04 | 0.5 | unk | 0 | 0 | N | N (2014) |
| Cuvier's beaked whale | Western North Atlantic | NEC | 6,532 | 0.32 | 5,021 | 0.04 | 0.5 | 50 | 0.4 | 0.2 | N | N (2013) |
| Blainville’s beaked whale | Western North Atlantic | NEC | 7,092[i] | 0.54 | 4,632 [i] | 0.04 | 0.5 | 46 | 0.2 | 0.2 | N | N (2013) |
| Gervais beaked whale | Western North Atlantic | NEC | 7,092[i] | 0.54 | 4,632 [i] | 0.04 | 0.5 | 46 | 0 | 0 | N | N (2013) |
| Sowerby’s beaked whale | Western North Atlantic | NEC | 7,092[i] | 0.54 | 4,632 [i] | 0.04 | 0.5 | 46 | 0 | 0 | N | N (2014) |
| True’s beaked whale | Western North Atlantic | NEC | 7,092[i] | 0.54 | 4,632 [i] | 0.04 | 0.5 | 46 | 0 | 0 | N | N (2013) |

| Species | Stock Area | NMFS Ctr. | Nbest | Nbest CV | Nmin | Rmax | Fr | PBR | Total Annual S.I and Mort. | Annual Fish. S.I. and Mort. (cv) | Strategic Status | SAR Revised |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Melon-headed whale | Western North Atlantic | SEC | unk | unk | unk | 0.04 | 0.5 | unk | 0 | 0 | N | N (2007) |
| Risso's dolphin | Western North Atlantic | NEC | 18,250 | 0.46 | 12,619 | 0.04 | 0.48 | 126 | 53.6 | 53 (0.28) | N | Y (m) |
| Pilot whale, long-finned | Western North Atlantic | NEC | 5,636 | 0.63 | 3,464 | 0.04 | 0.5 | 35 | 38 | 38 (0.15) | Y | Y (m, status) |
| Pilot whale, short-finned | Western North Atlantic | SEC | 21,515 | 0.37 | 15,913 | 0.04 | 0.5 | 159 | 192 | 192 (0.17) | Y | Y (m, status) |
| Atlantic white-sided dolphin | Western North Atlantic | NEC | 48,819 | 0.61 | 30,403 | 0.04 | 0.5 | 304 | 74 | 74 (0.2) | N | Y (m) |
| White-beaked dolphin | Western North Atlantic | NEC | 2,003 | 0.94 | 1,023 | 0.04 | 0.5 | 10 | 0 | 0 | N | N (2007) |
| Common dolphin | Western North Atlantic | NEC | 70,184 | 0.28 | 55,690 | 0.04 | 0.5 | 557 | 409 | 409 (0.10) | N | Y (a, m, p) |
| Atlantic spotted dolphin | Western North Atlantic | SEC | 44.715 | 0.43 | 31,610 | 0.04 | 0.5 | 316 | 0 | 0 | N | N (2013) |
| Pantropical spotted dolphin | Western North Atlantic | SEC | 3,333 | 0.91 | 1,733 | 0.04 | 0.5 | 17 | 0 | 0 | N | N (2013) |
| Striped dolphin | Western North Atlantic | NEC | 54,807 | 0.3 | 42,804 | 0.04 | 0.5 | 428 | 0 | 0 | N | N (2013) |
| Fraser's dolphin | Western North Atlantic | SEC | unk | unk | unk | 0.04 | 0.5 | unk | 0 | 0 | N | N (2007) |
| Rough-toothed dolphin | Western North Atlantic | SEC | 271 | 1.0 | 134 | 0.04 | 0.5 | 1.3 | 0 | 0 | N | N (2013) |
| Clymene dolphin | Western North Atlantic | SEC | unk | unk | unk | 0.04 | 0.5 | undet | 0 | 0 | N | N (2013) |
| Spinner dolphin | Western North Atlantic | SEC | unk | unk | unk | 0.04 | 0.5 | unk | 0 | 0 | N | N (2013) |
| Common bottlenose dolphin | Western North Atlantic, offshore | SEC | 77,532 [g] | 0.40 | 56,053[g] | 0.04 | 0.5 | 561 | 39.4 | 39.4 (0.29) | N | Y (m) |
| Common bottlenose dolphin | Western North Atlantic, northern migratory coastal | SEC | 11,548 | 0.36 | 8,620 | 0.04 | 0.5 | 86 | 1-7.5 | 1-7.5 | Y | N (2015) |
| Common bottlenose dolphin | Western North Atlantic, southern migratory coastal | SEC | 9,173 | 0.46 | 6,326 | 0.04 | 0.5 | 63 | 0-12 | 0-12 | Y | N (2015) |
| Common bottlenose dolphin | Western North Atlantic, S. Carolina/Georgia coastal | SEC | 4,377 | 0.43 | 3,097 | 0.04 | 0.5 | 31 | 1.2-1.6 | 1.2-1.6 | Y | N (2015) |
| Common bottlenose dolphin | Western North Atlantic, northern Florida coastal | SEC | 1,219 | 0.67 | 730 | 0.04 | 0.5 | 7 | 0.4 | 0.4 | Y | N (2015) |
| Common bottlenose dolphin | Western North Atlantic, central Florida coastal | SEC | 4,895 | 0.71 | 2,851 | 0.04 | 0.5 | 29 | 0.2 | 0.2 | Y | N (2015) |

| Species | Stock Area | NMFS Ctr. | Nbest | Nbest CV | Nmin | Rmax | Fr | PBR | Total Annual S.I and Mort. | Annual Fish. S.I. and Mort. (cv) | Strategic Status | SAR Revised |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Common bottlenose dolphin | Northern North Carolina Estuarine System | SEC | 823 | 0.06 | 782 | 0.04 | 0.5 | 7.8 | 1.0-16.7 | 1.0-16.7 | Y | N (2015) |
| Common bottlenose dolphin | Southern North Carolina Estuarine System | SEC | unk | unk | unk | 0.04 | 0.5 | undet | 0-0.4 | 0-0.4 | Y | N (2015) |
| Common bottlenose dolphin | Northern South Carolina Estuarine System | SEC | unk | unk | unk | 0.04 | 0.5 | unk | 0.2 | 0.2 | Y | N (2015) |
| Common bottlenose dolphin | Charleston Estuarine System | SEC | unk | unk | unk | 0.04 | 0.5 | undet | unk | unk | Y | N (2015) |
| Common bottlenose dolphin | Northern Georgia/ Southern South Carolina Estuarine System | SEC | unk | unk | unk | 0.04 | 0.5 | unk | 1.4 | 1.4 | Y | N (2015) |
| Common bottlenose dolphin | Central Georgia Estuarine System | SEC | 192 | 0.04 | 185 | 0.04 | 0.5 | 1.9 | unk | unk | Y | N (2015) |
| Common bottlenose dolphin | Southern Georgia Estuarine System | SEC | 194 | 0.05 | 185 | 0.04 | 0.5 | 1.9 | unk | unk | Y | N (2015) |
| Common bottlenose dolphin | Jacksonville Estuarine System | SEC | unk | unk | unk | 0.04 | 0.5 | unk | 1.2 | 1.2 | Y | N (2015) |
| Common bottlenose dolphin | Indian River Lagoon Estuarine System | SEC | unk | unk | unk | 0.04 | 0.5 | unk | 4.4 | 4.4 | Y | N (2015) |
| Common bottlenose dolphin | Biscayne Bay | SEC | unk | unk | unk | 0.04 | 0.5 | unk | unk | unk | Y | N (2013) |
| Common bottlenose dolphin | Florida Bay | SEC | unk | unk | unk | 0.04 | 0.5 | undet | unk | unk | N | N (2013) |
| Harbor porpoise | Gulf of Maine/Bay of Fundy | NEC | 79,833 | 0.32 | 61,415 | 0.046 | 0.5 | 706 | 437 | 437 (0.18) | N | Y (m) |
| Harbor seal | Western North Atlantic | NEC | 75,834 | 0.15 | 66,884 | 0.12 | 0.5 | 2,006 | 389 | 377 (0.13) | N | Y (m) |
| Gray seal | Western North Atlantic | NEC | unk | unk | unk | 0.12 | 1.0 | unk | 4,937 | 1,162 (0.11) | N | Y (m) |
| Harp seal | Western North Atlantic | NEC | unk | unk | unk | 0.12 | 1.0 | unk | 306,082[g] | 271 (0.19) | N | N (2013) |
| Hooded seal | Western North Atlantic | NEC | unk | unk | unk | 0.12 | 0.75 | unk | 5,199[h] | 25(0.82) | N | N (2007) |
| Sperm whale | Gulf of Mexico | SEC | 763 | 0.38 | 560 | 0.04 | 0.1 | 1.1 | 0 | 0 | Y | N (2015) |
| Bryde's whale | Gulf of Mexico | SEC | 33 | 1.07 | 16 | 0.04 | 0.1 | 0.03 | 0.2 | 0 | Y | N (2015) |
| Cuvier's beaked whale | Gulf of Mexico | SEC | 74 | 1.04 | 36 | 0.04 | 0.5 | 0.4 | 0 | 0 | N | N (2012) |
| Blainville's beaked whale | Gulf of Mexico | SEC | 149[i] | 0.91 | 77 | 0.04 | 0.5 | 0.8 | 0 | 0 | N | N (2012) |
| Gervais' beaked whale | Gulf of Mexico | SEC | 149[i] | 0.91 | 77 | 0.04 | 0.5 | 0.8 | 0 | 0 | N | N (2012) |
| Common bottlenose dolphin | Gulf of Mexico, Continental shelf | SEC | 51,192 | 0.10 | 46,926 | 0.04 | 0.5 | 469 | 0.8 | 0.6 | N | N (2015) |
| Common bottlenose dolphin | Gulf of Mexico, eastern coastal | SEC | 12,388 | 0.13 | 11,110 | 0.04 | 0.5 | 111 | 1.6 | 1.6 | N | N (2015) |

| Species | Stock Area | NMFS Ctr. | Nbest | Nbest CV | Nmin | Rmax | Fr | PBR | Total Annual S.I and Mort. | Annual Fish. S.I. and Mort. (cv) | Strategic Status | SAR Revised |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Common bottlenose dolphin | Gulf of Mexico, northern coastal | SEC | 7,185 | 0.21 | 6,044 | 0.04 | 0.5 | 60 | 0.4 | 0.4 | N | N (2015) |
| Common bottlenose dolphin | Gulf of Mexico, western coastal | SEC | 20,161 | 0.17 | 17,491 | 0.04 | 0.5 | 175 | 0.6 | 0.6 | N | N (2015) |
| Common bottlenose dolphin | Gulf of Mexico, Oceanic | SEC | 5,806 | 0.39 | 4,230 | 0.04 | 0.5 | 42 | 6.5 | 6.5 (0.65) | N | N (2014) |
| Common bottlenose dolphin | Gulf of Mexico, bay, sound and estuary (27 stocks) | SEC | unk for all but 3 stocks | unk | unk for all but 3 stocks | 0.04 | 0.5 | undet for all but 3 stocks | unk | unk | Y for all | Y stranding and fishery data |
| Common bottlenose dolphin | Barataria Bay | SEC | unk | unk | unk | 0.04 | 0.5 | undet | 0.8 | 0.8 | Y | N (2015) |
| Common bottlenose dolphin | Mississippi Sound, Lake Borgne, Bay Boudreau | SEC | 901 | 0.63 | 551 | 0.04 | 0.5 | 5.6 | 2.2 | 1.6 | Y | N (2015) |
| Common bottlenose dolphin | St. Joseph Bay | SEC | 152 | 0.08 | unk[l] | 0.04 | 0.5 | undet[l] | unk | unk | Y | N (2015)[l] |
| Common bottlenose dolphin | Choctawhatchee Bay | SEC | 179 | 0.04 | unk[l] | 0.04 | 0.5 | undet[l] | 0.4 | 0.4 | Y | N (2015)[l] |
| Atlantic spotted dolphin | Gulf of Mexico | SEC | unk | unk | unk | 0.04 | 0.5 | undet | 42 | 42 (0.45) | N | N (2015) |
| Pantropical spotted dolphin | Gulf of Mexico | SEC | 50,880 | 0.27 | 40,699 | 0.04 | 0.5 | 407 | 4.4 | 4.4 | N | N (2015) |
| Striped dolphin | Gulf of Mexico | SEC | 1,849 | 0.77 | 1,041 | 0.04 | 0.5 | 10 | 0 | 0 | N | N (2012) |
| Spinner dolphin | Gulf of Mexico | SEC | 11,441 | 0.83 | 6,221 | 0.04 | 0.5 | 62 | 0 | 0 | N | N (2012) |
| Rough-toothed dolphin | Gulf of Mexico | SEC | 624 | 0.99 | 311 | 0.04 | 0.4 | 3 | 0.8 | 0.8 (1.0) | N | Y (m) |
| Clymene dolphin | Gulf of Mexico | SEC | 129 | 1.00 | 64 | 0.04 | 0.5 | 0.6 | 0 | 0 | N | N (2012) |
| Fraser's dolphin | Gulf of Mexico | SEC | unk | unk | unk | 0.04 | 0.5 | undet | 0 | 0 | N | N (2012) |
| Killer whale | Gulf of Mexico | SEC | 28 | 1.02 | 14 | 0.04 | 0.5 | 0.1 | 0 | 0 | N | N (2012) |
| False killer whale | Gulf of Mexico | SEC | unk | unk | unk | 0.04 | 0.5 | undet | 0 | 0 | N | N (2012) |
| Pygmy killer whale | Gulf of Mexico | SEC | 152 | 1.02 | 75 | 0.04 | 0.5 | 0.8 | 0 | 0 | N | N (2012) |
| Dwarf sperm whale | Gulf of Mexico | SEC | 186[j] | 1.04 | 90 | 0.04 | 0.5 | 0.9 | 0 | 0 | N | N (2012) |
| Pygmy sperm whale | Gulf of Mexico | SEC | 186[j] | 1.04 | 90 | 0.04 | 0.5 | 0.9 | 0.3 | 0.3 (1.0) | N | N (2012) |
| Melon-headed whale | Gulf of Mexico | SEC | 2,235 | 0.75 | 1,274 | 0.04 | 0.5 | 13 | 0 | 0 | N | N (2012) |
| Risso's dolphin | Gulf of Mexico | SEC | 2,442 | 0.57 | 1,563 | 0.04 | 0.5 | 16 | 7.9 | 7.9 (0.85) | N | N (2015) |
| Pilot whale, short-finned[l] | Gulf of Mexico | SEC | 2,415 | 0.66 | 1456 | 0.04 | 0.5 | 15 | 0.5 | 0.5 (1.0) | N | N (2015) |
| Sperm Whale | Puerto Rico and US Virgin Islands | SEC | unk | unk | unk | 0.04 | 0.1 | unk | unk | unk | Y | N (2010) |
| Common bottlenose dolphin | Puerto Rico and US Virgin Islands | SEC | unk | unk | unk | 0.04 | 0.5 | unk | unk | unk | Y | N (2011) |
| Cuvier's beaked whale | Puerto Rico and US Virgin Islands | SEC | unk | unk | unk | 0.04 | 0.5 | unk | unk | unk | Y | N (2011) |

| Species | Stock Area | NMFS Ctr. | Nbest | Nbest CV | Nmin | Rmax | Fr | PBR | Total Annual S.I and Mort. | Annual Fish. S.I. and Mort. (cv) | Strategic Status | SAR Revised |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pilot whale, short-finned | Puerto Rico and US Virgin Islands | SEC | unk | unk | unk | 0.04 | 0.5 | unk | unk | unk | Y | N (2011) |
| Spinner dolphin | Puerto Rico and US Virgin Islands | SEC | unk | unk | unk | 0.04 | 0.5 | unk | unk | unk | Y | N (2011) |
| Atlantic spotted dolphin | Puerto Rico and US Virgin Islands | SEC | unk | unk | unk | 0.04 | 0.5 | unk | unk | unk | Y | N (2011) |

a. The R given for right whales is the default Rmax of 0.04. The total estimated human-caused mortality and serious injury to right whales is estimated at 5.66 per year. This is derived from two components: 1) non-observed fishery entanglement records at 4.65 per year, and 2) ship strike records at 1.01 per year.

b. The total estimated human-caused mortality and serious injury to the Gulf of Maine humpback whale stock is estimated as 9.05 per year. This average is derived from two components: 1) incidental fishery interaction records 7.25; 2) records of vessel collisions, 1.8.

c. The total estimated human-caused mortality and serious injury to the Western North Atlantic fin whale stock is estimated as 3.8 per year . This average is derived from two components: 1) incidental fishery interaction records 1.8; 2) records of vessel collisions, 2.0.

d. The total estimated human-caused mortality and serious injury to the Nova Scotia sei whale stock is estimated as 0.8 per year. This average is derived from two components: 1) incidental fishery interaction records 0; 2) records of vessel collisions, 0.8.

e. The total estimated human-caused mortality and serious injury to the Canadian East Coast minke whale stock is estimated as 8.25 per year. This average is derived from three components: 1) 0.2 minke whales per year from observed U.S. fisheries; 2) 6.45 minke whales per year (unknown CV) from U.S. and Canadian fisheries using strandings and entanglement data; and 3) 1.6 per year from ship strikes.

f. Estimates may include sightings of the coastal form.

g. The total estimated human caused annual mortality and serious injury to harp seals is 306,082. Estimated annual human caused mortality in US waters is 271 harp seals (CV=0.19) from the observed US fisheries. The remaining mortality is derived from five components: 1) 2007-2011 average catches of Northwest Atlantic harp seals by Canada, 125,751; 2) 2007-2011 average Greenland Catch, 79,181; 3) 1,000 average catches in the Canadian Arctic; 4) 12,330 average bycatches in the Newfoundland lumpfish fishery; and 5) 87,546 average struck and lost animals.

h. This is derived from three components: 1) 5,173 from 2001-2005 (2001 = 3,960; 2002 = 7,341; 2003 = 5,446, 2004=5,270; and 2005=3,846) average catches of Northwest Atlantic population of hooded seals by Canada and Greenland; 2) 25 hooded seals (CV=0.82) from the observed U.S. fisheries; and 3) one hooded seal from average 2001-2005 stranding mortalities resulting from non-fishery human interactions.

i. This estimate includes Gervais' beaked whales and Blainville's beaked whales for the Gulf of Mexico stocks, and all species of *Mesoplodon* in the Atlantic.

j. This estimate includes both the dwarf and pygmy sperm whales.

k. This estimate includes all *Globicephala sp.*, though it is presumed that only short-finned pilot whales are present in the Gulf of Mexico.

l. The individual SAR for this stock was not updated; however, Table 1 within the "Northern Gulf of Mexico Bay, Sound and Estuary Stocks" SAR, that includes basic information for all individual bay, sound and estuary stocks, was updated to reflect the changes in Nmin and PBR.

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

## STOCK DEFINITION AND GEOGRAPHIC RANGE

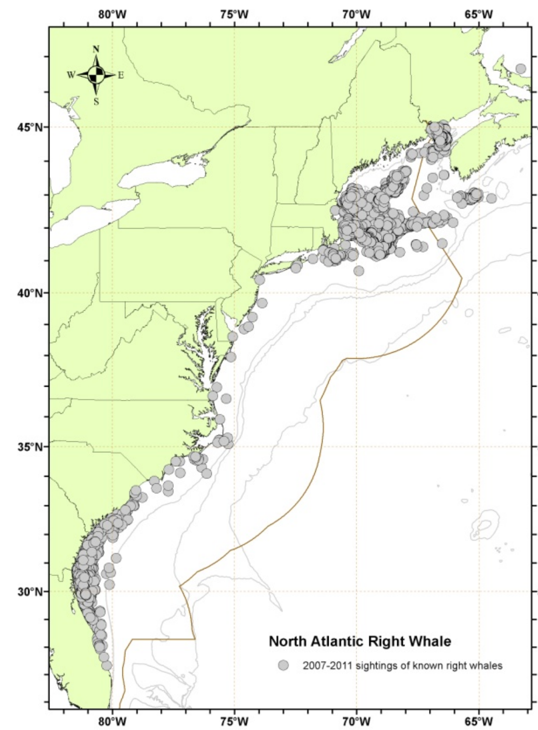


**Figure 1**. *Distribution of sightings of known North Atlantic right whales, 2007-2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

The western North Atlantic right whale population ranges primarily from calving grounds in coastal waters of the southeastern United States to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence. Mellinger *et al.* (2011) reported acoustic detections of right whales near the nineteenth-century whaling grounds east of southern Greenland, but the number of whales and their origin is unknown. However, Knowlton *et al.* (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland. In addition, resightings of photographically identified individuals have been made off Iceland, in the old Cape Farewell whaling ground east of Greenland (Hamilton *et al.* 2007), northern Norway (Jacobsen *et al.* 2004), and the Azores (Silva *et al.* 2012). The September 1999 Norwegian sighting represents one of only two published sightings in the 20th century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. A few published records from the Gulf of Mexico (Moore and Clark 1963; Schmidly *et al.* 1972; Ward-Geiger *et al.* 2011) likely represent occasional wanderings of individual female and calf pairs beyond the sole known calving and wintering ground in the waters of the southeastern United States. Whatever the case, the location of much of the population is unknown during the winter. Surveys flown in an area from 17 to 86 miles from the shoreline off northeastern Florida and southeastern Georgia from 1996 to 2001 had 3 sightings in 1996, 1 in 1997, 13 in 1998, 6 in 1999, 11 in 2000, and 6 in 2001 (within each year, some were repeat sightings of previously recorded individuals). All but 1 of the sightings occurred within 49 miles of the shoreline –the remaining sighting occurred ~75 miles offshore (search effort was unevenly distributed).  An offshore survey in March 2010 observed the birth of a right whale in waters 40 miles off Jacksonville, Florida (Foley *et al.* 2011). Several years of aerial survey counts for calves and adults were the lowest recorded since comprehensive surveys began in the Southeast calving grounds. Although habitat models predict right whales are not likely to occur further than 49 miles from the shoreline (Gowan and Ortega-Ortiz, 2015), the frequency with which right whales occur in offshore waters in the southeastern United States remains unclear.

Visual and acoustic surveys have demonstrated the existence of seven areas where western North Atlantic right whales aggregate seasonally: the coastal waters of the southeastern United States; the Great South Channel; Jordan Basin; Georges Basin along the northeastern edge of Georges Bank; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Roseway Basin on the Scotian Shelf (Brown *et al*. 2001; Cole *et al.* 2013). Passive acoustic studies of right whales have demonstrated their year-round presence in the Gulf of Maine (Morano *et al.* 2012; Bort *et al.* 2015), New Jersey (Whitt *et al.* 2013)), and Virginia (Salisbury *et al*. 2015). Additionally, right whales were acoustically detected off Georgia and North Carolina in 7 of 11 months monitored (Hodge *et al*. 2015),). All of this work further demonstrates the highly mobile nature of right whales. Movements within and between habitats are extensive and the area off the mid-Atlantic states is an important migratory corridor. In 2000, one whale was photographed in Florida waters on 12 January, then again 11 days later (23 January) in Cape Cod Bay, less than a month later off Georgia (16 February), and back in Cape Cod Bay on 23 March, effectively making the round-trip migration to the Southeast and back at least twice during the winter season (Brown and Marx 2000). Results from satellite tagging studies clearly indicate that sightings separated by perhaps two weeks should not necessarily be assumed to indicate a stationary or resident animal. Instead, telemetry data have shown rather lengthy and somewhat distant excursions, including into deep water off the continental shelf (Mate *et al.* 1997; Baumgartner and Mate 2005). Systematic visual surveys conducted off the coast of North Carolina during the winters of 2001 and 2002 sighted 8 calves, suggesting the calving grounds may extend as far north as Cape Fear (McLelland, et al., 2008, Contract report available from SE regional Office, NMFS). Four of those calves were not sighted by surveys conducted further south. One of the females photographed was new to researchers, having effectively eluded identification over the period of its maturation. In 2016 the Southeastern U.S. Calving Area Critical Habitat was expanded north to Cape Fear, North Carolina. There is also at least one recent case of a calf apparently being born in the Gulf of Maine (Patrician *et al*. 2009) and another newborn was detected in Cape Cod Bay in 2013.

New England waters are important feeding habitats for right whales, where they feed primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*). Right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitats (Kenney *et al.* 1986, 1995). While feeding in the coastal waters off Massachusetts has been better studied than in other areas, right whale feeding has also been observed on the margins of Georges Bank, in the Great South Channel, in the Gulf of Maine, in the Bay of Fundy, and over the Scotian Shelf (Baumgartner *et al.* 2007). The characteristics of acceptable prey distribution in these areas are beginning to emerge (Baumgartner *et al.* 2003; Baumgartner and Mate 2003). NMFS (National Marine Fisheries Service) and Center for Coastal Studies aerial surveys during springs of 1999–2006 found right whales along the Northern Edge of Georges Bank, in the Great South Channel, in Georges Basin, and in various locations in the Gulf of Maine including Cashes Ledge, Platts Bank, and Wilkinson Basin. Analysis of the sightings data has shown that utilization of these areas has a strong seasonal component (Pace and Merrick 2008). Although right whales are consistently found in these locations, studies also highlight the high interannual variability in right whale use of some habitats (Pendleton *et al.* 2009). In 2016, the Northeastern U.S. Foraging Area Critical Habitat was expanded to include all U.S. waters of the Gulf of Maine. In the most recent years (2012–2015), surveys have detected fewer individuals in the Great South Channel and the Bay of Fundy, indicating an important shift in habitat use patterns.

Right whale calls have been detected by autonomous passive acoustic sensors deployed between 2005 and 2010 at three sites (Massachusetts Bay, Stellwagen Bank, and Jeffreys Ledge) in the southern Gulf of Maine (Morano *et al*. 2012, Mussoline *et al*. 2012). Comparisons between detections from passive acoustic recorders and observations from aerial surveys in Cape Cod Bay between 2001 and 2005 demonstrated that aerial surveys found whales on approximately two-thirds of the days during which acoustic monitoring detected whales (Clark *et al*. 2010). These data suggest that the current understanding of the distribution and movements of right whales in the Gulf of Maine and surrounding waters is incomplete.

Genetic analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified 7 mtDNA haplotypes in the western North Atlantic right whale, including heteroplasmy that led to the declaration of the 7$^{th}$ haplotype (Malik *et al.* 1999, McLeod and White 2010). Schaeff *et al.* (1997) compared the genetic variability of North Atlantic and southern right whales (*E. australis*), and found the former to be significantly less diverse, a finding broadly replicated by Malik *et al.* (2000). The low diversity in North Atlantic right whales might be indicative of inbreeding, but no definitive conclusion can be reached using current data. Modern and historic genetic population structures were compared using DNA extracted from museum and archaeological specimens of baleen and bone. This work suggested that the eastern and western North Atlantic populations were not genetically distinct (Rosenbaum *et al.* 1997, 2000). However, the virtual extirpation of the eastern stock and its lack of recovery in the last hundred years strongly suggest population subdivision over a protracted (but not evolutionary) timescale. Genetic studies concluded that the principal loss of genetic diversity occurred prior to the 18$^{th}$ century (Waldick *et al.* 2002). However, revised conclusions that nearly all the remains in the North American Basque whaling archaeological sites were bowhead whales (*Balaena mysticetus*) and not right whales (Rastogi *et al.* 2004; McLeod *et al.* 2008) contradict the previously held belief that Basque whaling during the 16$^{th}$ and 17$^{th}$ centuries was principally responsible for the loss of genetic diversity.

High-resolution (i.e., using 35 microsatellite loci) genetic profiling has been completed for 66% of all North Atlantic right whales identified through 2001. This work has improved our understanding of genetic variability, number of reproductively active individuals, reproductive fitness, parentage, and relatedness of individuals (Frasier *et al.* 2007).

One emerging result of the genetic studies is the importance of obtaining biopsy samples from calves on the calving grounds. Only 60% of all known calves are seen with their mothers in summering areas, when their callosity patterns are stable enough to reliably make a photo-ID match later in life. The remaining 40% are not seen on a known summering ground. Because the calf's genetic profile is the only reliable way to establish parentage, if the calf is not sampled when associated with its mother early on, then it is not possible to link it with a calving event or to its mother, and information such as age and familial relationships is lost. From 1980 to 2001, there were 64 calves born that were not sighted later with their mothers and thus unavailable to provide age-specific mortality information (Frasier *et al.* 2007). An additional interpretation of paternity analyses is that the population size may be larger than was previously thought. Fathers for only 45% of known calves have been genetically determined. However, genetic profiles were available for 69% of all photo-identified males (Frasier 2005). The conclusion was that the majority of these calves must have different fathers that cannot be accounted for by the unsampled males, therefore the population of males must be larger (Frasier 2005). This inference of additional animals that have never been captured photographically and/or genetically suggests the existence of potentially important habitats that remain to be described.

## POPULATION SIZE

The western North Atlantic minimum stock size is based on a census of individual whales identified using photo-identification techniques. A review of the photo-ID recapture database as it existed on 17 November 2015 indicated that 440 individually recognized whales in the catalog were known to be alive during 2012. This number represents a minimum population size. This is a direct count and has no associated coefficient of variation.

### Historical Abundance

An estimate of pre-exploitation population size is not available. Basque whalers were thought to have taken right whales during the 1500s in the Strait of Belle Isle region (Aguilar 1986), however, genetic analysis has shown that nearly all of the remains found in that area are, in fact, those of bowhead whales (Rastogi *et al.* 2004; Frasier *et al.* 2007). The stock of right whales may have already been substantially reduced by the time whaling was begun by colonists in the Plymouth area in the 1600s (Reeves *et al.* 2001, 2007). A modest but persistent whaling effort along the coast of the eastern U.S. lasted three centuries, and the records include one report of 29 whales killed in Cape Cod Bay in a single day during January 1700. Reeves *et al.* (2007) calculated that a minimum of 5500 right whales were taken in the western North Atlantic between 1634 and 1950, with nearly 80% taken in a 50-year period between 1680 and 1730. They concluded "there were at least a few thousand whales present in the mid-1600s." The authors cautioned, however, that the record of removals is incomplete, the results were preliminary, and refinements are required. Based on back calculations using the present population size and growth rate, the population may have numbered fewer than 100 individuals by 1935 when international protection for right whales came into effect (Hain 1975; Reeves *et al.* 1992; Kenney *et al.* 1995). However, little is known about the population dynamics of right whales in the intervening years.

### Minimum Population Estimate

The western North Atlantic population size was estimated to be at least 440 individuals in 2012.

### Current Population Trend

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

An increase in carcass detections in 2004 and 2005 was cause for serious concern (Kraus *et al.* 2005). Of those mortalities, six were adult females, three of which were carrying near-term fetuses. Furthermore, four of these females were just starting to bear calves, losing their complete lifetime reproduction potential. Calculations based on demographic data through 1999 (Fujiwara and Caswell 2001) indicated that this mortality rate increase would reduce population growth by approximately 10% per year (Kraus *et al.* 2005). Strong evidence for flat or negative growth exists in the time series of minimum number alive during 1998-2000, which coincided with very low calf production in 2004. However, the population continued to grow since that apparent interval of decline until the most recent year included in this analysis (Figure 2).

Examination of the minimum number alive calculated from the individual sightings database, as it existed on 27 October 2015, for the years 1990–2012 (Figure 2) suggests that abundance has declined. As noted above, there seems to have been a considerable change in right whale habitat use patterns in areas where most of the population has been observed in previous years. This apparent change in habitat use has the effect that, despite relatively constant effort to find whales, the chance of seeing an individual that is alive has decreased. Some caution is advised in interpreting the apparent downward trend in abundance in 2012, but without evidence to the contrary, it is possible that this deflection represents a true population decline.

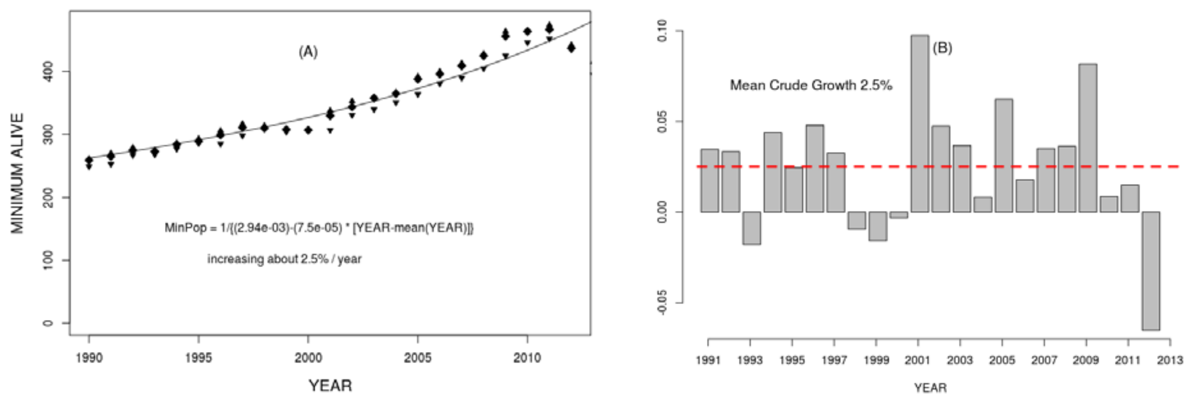


*Figure 2. Minimum number alive (a) for North Atlantic right whales. Minimum number alive (diamonds) of cataloged individuals known to be alive in any given year includes all whales known to be alive prior to that year and seen in that year or subsequently plus all whales newly cataloged that year. Cataloged whales may include some but not all calves produced each year. Bracketing the minimum number of cataloged whales is the number without calves (below) and that plus calves above, the latter which yields Nmin for purposes of stock assessment. (b) Crude annual growth rates from the minimum number alive values. Mean crude growth rate (dashed line) is the exponentiated mean of* $\log_e [(N_{t+1}-N_t)/N_t]$ *for each year (t), where* $N_t$ *is the max of the accounting procedure and the estimated abundance for year t.*

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

During 1990–2014, at least 411 calves were born into the population. The number of calves born annually ranged from 1 to 39, and averaged 16.4 but was highly variable (SD=9.2). The fluctuating abundance observed from 1990 to 2014 makes interpreting a count of calves by year less clear than measuring population productivity, which we index by the number of calves detected/Nmin. Productivity for this stock has been highly variable over time and has been characterized by periodic swings in per capita birth rates (Figure 3). Notwithstanding the high variability observed, which might be expected from a small population, productivity in North Atlantic right whales lacks a definitive trend.

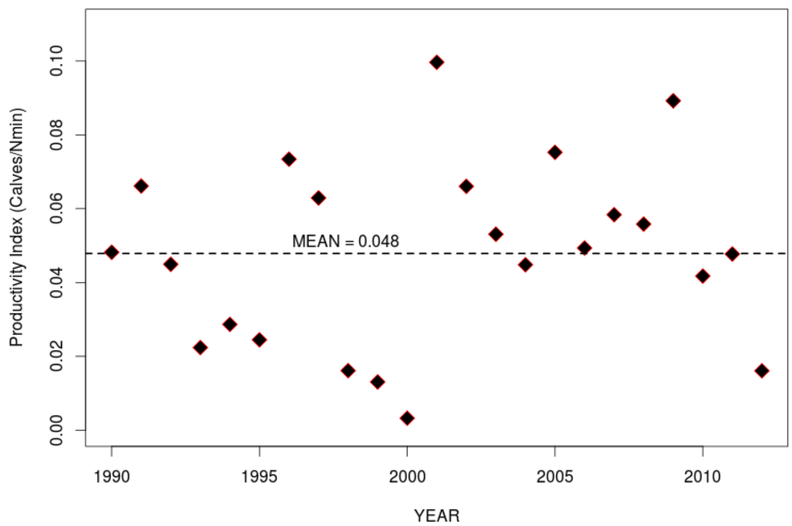


*Figure 3. Productivity in the North Atlantic right whale population as characterized by calves detected/($N_{min}$). Note that because Nmin is likely biased somewhat low, the values shown in the graph likely overstate actual per capita production.*

North Atlantic right whales have thinner blubber than southern right whales off South Africa (Miller *et al.* 2011). Blubber thickness of male North Atlantic right whales (males were selected to avoid the effects of pregnancy and lactation) varied with *Calanus* abundance in the Gulf of Maine (Miller *et al.* 2011). Sightings of North Atlantic right whales correlated with satellite-derived sea-surface chlorophyll concentration (as a proxy for productivity), and calving rates correlated with chlorophyll concentration prior to gestation (Hlista *et al.* 2009). On a regional scale, observations of North Atlantic right whales correlate well with copepod concentrations (Pendleton *et al*. 2009). The available evidence suggests that at least some of the observed variability in the calving rates of North Atlantic right whales is related to variability in nutrition.

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

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

## POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is the product of minimum population size, one-half the maximum net productivity rate and a recovery factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The recovery factor for right whales is 0.10 because this species is listed as endangered under the Endangered Species Act (ESA). The minimum population size is 440. The maximum productivity rate is 0.04, the default value for cetaceans. PBR for the Western Atlantic stock of the North Atlantic right whale is 1.

## ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2010 through 2014, the minimum rate of annual human-caused mortality and serious injury to right whales averaged 5.66 per year. This is derived from two components: 1) incidental fishery entanglement records at 4.65 per year, and 2) vessel strike records at 1.01 per year. Early analyses of the effectiveness of the ship strike rule were reported by Silber and Bettridge (2012). Recently, van der Hoop *et al.* (2015) concluded that large whale mortalities due to vessel strikes decreased inside active SMAs and increased outside inactive SMAs. Analysis by Laist *et al.* (2014) incorporated an adjustment for drift around areas regulated under the ship strike rule and produced weak evidence that the rule was effective inside the SMAs.

Beginning with the 2001 Stock Assessment Report, Canadian records have been incorporated into the mortality and serious injury rates to reflect the effective range of this stock. It is also important to stress that serious injury determinations are made based upon the best available information; these determinations may change with the availability of new information (Henry *et al.* 2016). For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries. Annual rates calculated from detected mortalities should not be considered an unbiased estimate of human-caused mortality, but they represent a definitive lower bound. Detections are haphazard, incomplete, and not the result of a designed sampling scheme. As such they represent a minimum estimate of human-caused mortality, which is biased low.

**Background**

The details of a particular mortality or serious injury record often require a degree of interpretation (Moore *et al.* 2005). The assigned cause is based on the best judgment of the available data; additional information may result in revisions. When reviewing Table 1 below, several factors should be considered: 1) a vessel strike or entanglement may have occurred at some distance from the location where the animal is detected/reported; 2) the mortality or injury may involve multiple factors; for example, whales that have been both vessel struck and entangled are not uncommon; 3) the actual vessel or gear type/source is often uncertain; and 4) in entanglements, several types of gear may be involved.

Further, the small population size and low annual reproductive rate of right whales suggest that human sources of mortality may have a greater effect relative to population growth rates than for other whales. The principal factors believed to be retarding growth and recovery of the population are vessel strikes and entanglement with fishing gear. Between 1970 and 1999, a total of 45 right whale mortalities was recorded (IWC 1999; Knowlton and Kraus 2001; Glass *et al.* 2009). Of these, 13 (28.9%) were neonates that were believed to have died from perinatal complications or other natural causes. Of the remainder, 16 (35.6%) resulted from vessel strikes, 3 (6.7%) were related to entanglement in fishing gear (in two cases lobster gear, and one gillnet gear), and 13 (28.9%) were of unknown cause. At a minimum, therefore, 42.2% of the observed total for the period and 50% of the 32 non-calf deaths was attributable to human impacts (calves accounted for three deaths from ship strikes). Young animals, ages 0-4 years, are apparently the most impacted portion of the population (Kraus 1990).

Finally, entanglement or minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so that it is more likely to become vulnerable to further injurySerious injury determinations for large whales commonly include animals carrying gear when these entanglements are constricting or appear to interfere with foraging (Henry *et al*. 2016).

**Fishery-Related Mortality and Serious Injury**

Reports of mortality and serious injury relative to PBR as well as total human impacts are contained in records maintained by the New England Aquarium and the NMFS Northeast and Southeast Regional Offices (Table 1). From 2010 through 2014, 24 records of mortality or serious injury (including records from both U.S. and Canadian waters, pro-rated to 23.25 using serious injury guidelines) involved entanglement or fishery interactions. For this time frame, the average reported mortality and serious injury to right whales due to fishery entanglement was 4.65 whales per year. Information from an entanglement event often does not include the detail necessary to assign the entanglements to a particular fishery or location.

Although disentanglement is often unsuccessful or not possible for many cases, there are several documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious-injury determination. Four serious injuries were prevented by intervention during 2010–2014 (Henry *et al.* 2016). Sometimes, even with disentanglement, an animal may die of injuries sustained from fishing gear. A female yearling right whale, #3107, was first sighted with gear wrapping its caudal peduncle on 6 July 2002 near Briar Island, Nova Scotia. Although the gear was removed on 1 September by the New England Aquarium disentanglement team, and the animal seen alive during an aerial survey on 1 October, its carcass washed ashore at Nantucket on 12 October 2002 with deep entanglement injuries on the caudal peduncle. Additionally, but infrequently, a whale listed as seriously injured becomes gear-free without a disentanglement effort and is seen later in reasonable health. Such was the case for whale #1980, listed as a serious injury in 2008 but seen gear-free and apparently healthy in 2011.

The only bycatch of a right whale observed by the Northeast Fisheries Observer Program was in the pelagic drift gillnet fishery in 1993. No mortalities or serious injuries have been documented by fisheries observers in any of the other fisheries monitored by NMFS.

Whales often free themselves of gear following an entanglement event, and as such scarring may be a better indicator of fisheries interaction than entanglement records. A review of scars detected on identified individual right whales over a period of 30 years (1980–2009) documented 1032 definite, unique entanglement events on the 626 individual whales identified (Knowlton *et al*. 2012). Most individual whales (83%) were entangled at least once, and almost half of them (306 of 626) were entangled more than once. About a quarter of the individuals identified in each year (26%) were entangled in that year. Juveniles and calves were entangled at higher rates than were adults. Scarring rates suggest that entanglements are occurring at about an order of magnitude greater than that detected from observations of whales with gear on them. More recently, analyses of whales carrying entangling gear also suggest that entanglement wounds have become more severe since 1990, possibly due to increased use of stronger lines in fixed fishing gear (Knowlton *et al*. 2015).

Knowlton *et al.* (2012) concluded from their analysis of entanglement scarring rates over time that efforts made since 1997 to reduce right whale entanglement had not worked. Working from a completely different data source (observed mortalities of eight large whale species, 1970–-2009), van der Hoop *et al*. (2012) arrived at a similar conclusion. Vessel strikes and entanglements were the two leading causes of death for known mortalities of right whales for which a cause of death could be determined. Across all 8 species of large whales, there was no detectable change in causes of anthropogenic mortality over time (van der Hoop *et al*. 2012). Pace *et al.* (2015) analyzed entanglement rates and serious injuries due to entanglement during 1999-2009 and found no support that mitigation measures that were implemented prior to 2009 were effective at reducing takes due to commercial fishing.

Incidents of entanglements in waters of Atlantic Canada and the U.S. east coast were summarized by Read (1994) and Johnson *et al.* (2005). In six records of right whales that were entangled in groundfish gillnet gear in the Bay of Fundy and Gulf of Maine between 1975 and 1990, the whales were either released or escaped on their own, although several whales were observed carrying net or line fragments. A right whale mother and calf were released alive from a herring weir in the Bay of Fundy in 1976. Gillnet gear entanglements in the U.S. can also be fatal. A calf died in 2006, apparently victim of a gillnet entanglement, and other whales initially detected in gillnet gear have subsequently not been seen alive (NMFS unpub. data).

For all areas, specific details of right whale entanglement in fishing gear are often lacking. When direct or indirect mortality occurs, some carcasses come ashore and are subsequently examined, or are reported as "floaters" at sea. The number of unreported and unexamined carcasses is unknown, but may be significant in the case of floaters. More information is needed about fisheries interactions and where they occur.

**Other Mortality**

Vessel strikes are a major cause of mortality and injury to right whales (Kraus 1990; Knowlton and Kraus 2001, van der Hoop *et al.* 2012). Records from 2010 through 2014 have been summarized in Table 1. For this time frame, the average reported mortality and serious injury to right whales due to vessel strikes was 1.01 whales per year.

| Table 1. Confirmed human-caused mortality and serious injury records of North Atlantic right whales (*Eubalaena glacialis*) where the cause was assigned as either an entanglement (EN) or a vessel strike (VS): 2010-2014 [a] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date[b] | Injury Determination | ID | Location[b] | Asigned Cause | Value against PBR[c] | Country[d] | Gear Type[e] | Description |
| 6/27/2010 | Mortality | 1124 | off Cape May, NJ | EN | 1 | XU | NR | Evidence of constricting rostrum, mouth & pectoral wraps w/associated hemorrhage & bone damage. |
| 7/2/2010 | Mortality | 3901 | off Great Wass Island, ME | VS | 1 | XU | - | 2 large lacerations from dorsal to ventral surface. |
| 8/12/2010 | Mortality | 1113 | Digby Neck, NS | EN | 1 | XC | NP | Evidence of entanglement w/associated hemorrhaging around right pectoral. |
| 9/10/2010 | Serious Injury | 1503 | Jeffreys Ledge, NH | EN | 1 | XU | NR | Constricting wrap on rostrum. Poor health. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 12/25/2010 | Mortality | 3911 | off Jacksonville Beach, FL | EN | 1 | XU | GU | Constricting wraps w/ severe health decline. Sedation & partial disentanglement. Carcass recovered w/ embedded line on flipper & in mouth. |
| 1/20/2011 | Serious Injury | 3853 | off Edisto Island, SC | VS | 1 | US | - | Sixteen deep lacerations across back, potentially penetrating body cavity. |
| 2/13/2011 | Serious Injury | 3993 | off Tybee Island, GA | EN | 1 | XU | NR | Right pectoral compromised, likely necrotic. Emaciated & poor skin condition. |
| 3/16/2011 | Mortality | - | Cape Romain, SC | EN | 1 | XU | GU | Multiple wraps embedded in right pectoral bones. |
| 3/27/2011 | Mortality | 1308 | Nags Head, NC | VS | 1 | US | - | Fractured right skull. |
| 3/27/2011 | Serious Injury | 2011 Calf of 1308 | Nags Head, NC | VS | 1 | US | - | Dependent calf of mom that was killed by ship strike. |
| 4/22/2011 | Serious Injury | 3302 | off Martha's Vineyard, MA | EN | 1 | XU | NR | Constricting wrap on head. |

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| 9/3/2011 | Serious Injury | 2660 | Gaspe Bay, QC | EN | 1 | XC | NP | Evidence of extensive, constricting entanglement. Significant health decline: cyamids, sloughing skin. Right blow hole not functional. |
| 9/18/2011 | Prorated Injury | 4090 | Jeffreys Ledge, NH | EN | 0.75 | XU | NR | Full configuration unknown. |
| 9/27/2011 | Prorated Injury | 3111 | off Grand Manan Island, NB | EN | 0.75 | XC | NR | Constricting wrap on left flipper. Disentanglement attempted, but unsure if any cuts made. Final entanglement configuration unknown. Resight in 2012 did not confirm configuration or if still entangled, but health apparently improved. |
| 2/15/2012 | Serious Injury | 3996 | off Provincetown, MA | EN | 1 | XU | NR | Constricting gear across head and health decline. |
| 7/19/2012 | Mortality | - | Clam Bay, NS | EN | 1 | XC | GU | Multiple constricting wraps on peduncle; COD - peracute underwater entrapment. |
| 9/24/2012 | Serious Injury | 3610 | Bay of Fundy | EN | 1 | XC | NP | New significant raw & healing entanglement wounds on head, dorsal & ventral peduncle, and leading fluke edges. Health decline: moderate cyamid load, thin. |

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| 12/7/2012 | Prorated Injury | - | off Wassaw Island, GA | VS | 0.52 | US | - | 46' vessel, 12-13 kts struck whale. Animal not resighted but large expanding pool of blood at surface. |
| 12/18/2012 | Mortality | 4193 | off Palm Coast, FL | EN | 1 | US | PT | Constricting & embedded wraps w/ associated hemorrhaging at peduncle, mouthline, tongue, oral rete, rostrum & pectoral; malnourished. |
| 7/12/2013 | Prorated Injury | 3123 | off Virginia Beach, VA | EN | 0.75 | XU | NR | Constricting gear cutting into mouthline; Partially disentangled; final configuration unknown. |
| 1/15/2014 | Serious Injury | 4394 | off Ossabaw Island, GA | EN | 1 | XU | NR | Injuries indicating prior constricting gear on both pectorals and at fluke insertion. Injury to left ventral fluke. Evidence of health decline. |
| 4/1/2014 | Serious Injury | 1142 | off Atlantic City, NJ | EN | 1 | XU | NR | Constricting rostrum wrap with line trailing to at least mid-body. |
| 4/2/2014 | Serious Injury | 3390 | Cod Cape Bay | EN | 1 | XU | NP | Evidence of a rostrum wrap, body wrap just aft of blowholes, and damage to right pectoral, peduncle and leading fluke edges. Resights indicate health decline. |

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| 4/9/2014 | Prorated Injury | - | Cape Cod Bay | VS | 0.52 | US | - | Animal surfaced underneath R/V Shearwater (39ft) while it was underway @ 9 kts. Small amount of blood and some lacerations of unknown depth on lower left flank. |
| 6/29/2014 | Serious Injury | 1131 | off Yarmouth, NS | EN | 1 | XC | NR | At least 1, possibly 2, embedded rostrum wraps. Remaining configuration unclear but extensive. Animal in extremely poor condition: emaciated, heavy cyamid coverage, overall pale skin. |
| 9/4/2014 | Serious Injury | 4001 | off Grand Manan, NB | EN | 1 | XC | NR | Free-swimming with constricting rostrum wrap. |
| 9/4/2014 | Mortality | - | off St. Pierre & Miquelon, NL | EN | 1 | XC | NR | No necropsy conducted, but evidence of extensive, constricting entanglement - constricting line around rostrum and body. |
| 9/17/2014 | Serious Injury | 3279 | off Grand Manan, NB | EN | 1 | XC | NR | Free-swimming with heavy, green line over head cutting into nares. In poor overall condition: heavy cyamids on head and blowholes. Left blowhole appears compromised. |

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| 9/27/2014 | Mortality | - | off Nantucket, MA | EN | 1 | US | NR | No necropsy conducted, but fresh carcass with evidence of extensive, constricting entanglement - multiple line wraps around head, pectoral and peduncle. |
| 12/18/2014 | Serious Injury | 3670 | off Sapelo Sound, GA | EN | 1 | XU | NP | Portion of right lip torn away leaving an opening in mouth. Severe injuries to peduncle and leading & trailing fluke edges. Wrapping injuries on head and body. Possible damage to right pectoral. Resights indicate health decline. |
| Five-year averages | | Vessel strike (US/CN/XU/XC) | | 1.01 ( 0.81/ 0.00/ 0.20/ 0.00) | | | | |
| | | Entanglement (US/CN/XU/XC) | | 4.65 ( 0.40/ 0.00/ 2.5/ 1.75) | | | | |
| a. For more details on events please see Henry *et al.* 2016. | | | | | | | | |
| b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured. | | | | | | | | |
| c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012) | | | | | | | | |
| d. CN=Canada, US=United States, XC=Unassigned 1st sight in CN, XU=Unassigned 1st sight in US | | | | | | | | |
| e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir | | | | | | | | |

**STATUS OF STOCK**

The size of this stock is considered to be extremely low relative to OSP in the U.S. Atlantic EEZ, and this species is listed as endangered under the ESA. The North Atlantic right whale is considered one of the most critically endangered populations of large whales in the world (Clapham *et al.* 1999). Status review by the National Marine Fisheries Service affirms endangered status (NMFS Northeast Regional Office 2012). The total level of human-caused mortality and serious injury is unknown, but reported human-caused mortality and serious injury was a minimum of 5.65 right whales per year from 2010 through 2014. Given that PBR has been calculated as 1, any human-caused mortality or serious injury for this stock can be considered significant. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and also because the North Atlantic right whale is an endangered species.

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# HUMPBACK WHALE (*Megaptera novaeangliae*): Gulf of Maine Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

In the western North Atlantic, humpback whales feed during spring, summer and fall over a geographic range encompassing the eastern coast of the United States (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990). Other North Atlantic feeding grounds occur off Iceland, the Norwegian Sea, and northern Norway, including off Bear Island, Jan Mayen, and Franz Josef Land (Christensen *et al.* 1992; Palsbøll *et al.* 1997). These six regions represent relatively discrete subpopulations, fidelity to which is determined matrilineally (Clapham and Mayo 1987), which is supported by studies of the mitochondrial genome (Palsbøll *et al.* 1995; Palsbøll *et al.* 2001) and individual animal movements (Stevick *et al*. 2006). In early stock assessment reports, the North Atlantic humpback whale population was treated as a single stock for management purposes (Waring *et al.* 1999). Subsequently, a decision was made to reclassify the Gulf of Maine as a separate feeding stock (Waring *et al.* 2000) based upon the strong fidelity by individual whales to this region, and the attendant assumption that, were this subpopulation wiped out, repopulation by immigration from adjacent areas would not occur on any reasonable management timescale. During the 2002 Comprehensive Assessment of North Atlantic humpback whales, the International Whaling Commission acknowledged the evidence for treating the Gulf of Maine as a separate management unit (IWC 2002). During the summers of 1998 and 1999, the Northeast Fisheries Science Center conducted surveys for humpback whales on the Scotian Shelf to establish the occurrence and population identity of the animals found in this region, which lies between the well-studied populations of the Gulf of Maine and Newfoundland. Photographs from both surveys were compared to both the overall North Atlantic Humpback Whale Catalogue and a large regional catalogue from the Gulf of Maine (maintained by the College of the Atlantic and the Center for Coastal Studies, respectively); this work is summarized in Clapham *et al.* (2003). The match rate between the Scotian Shelf and the Gulf of Maine was 27% (14 of 52 Scotian Shelf individuals from both years). Comparable rates of exchange were obtained from the southern (28%, n=10 of 36 whales) and northern (27%, *n*=4 of 15 whales) ends of the Scotian Shelf (one whale was observed in both areas). In contrast, all of the 36 humpback whales identified by the same NMFS surveys elsewhere in the Gulf of Maine (including Georges Bank, southwestern Nova Scotia and the Bay of Fundy) had been previously observed in the Gulf of Maine region. The sighting histories of the 14 Scotian Shelf whales matched to the Gulf of Maine suggested that many of them were transient through the latter area. There were no matches between the Scotian Shelf and any other North Atlantic feeding ground, except the Gulf of Maine; however, instructive comparisons are compromised by the often low sampling effort in other regions in recent years. Overall, it appears that the northern range of many members of the Gulf of Maine stock does not extend onto the Scotian Shelf.

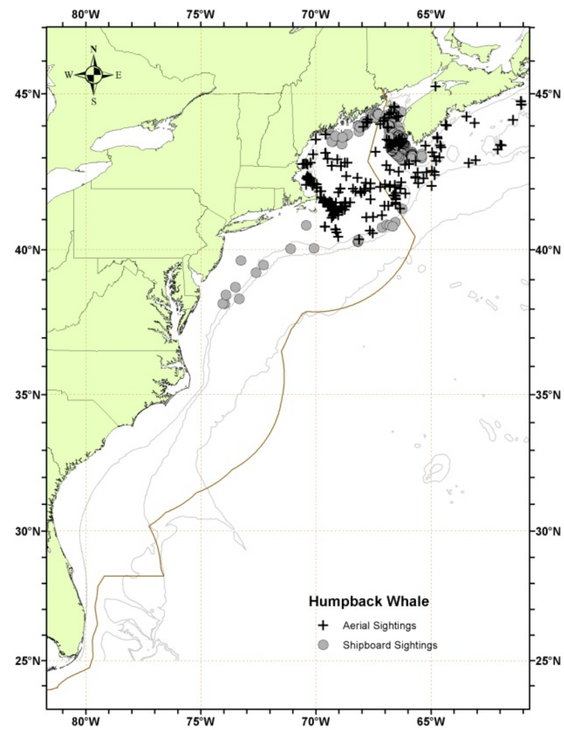


**Figure 1**. *Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

During winter, whales from most North Atlantic feeding areas (including the Gulf of Maine) mate and calve in the West Indies, where spatial and genetic mixing among feeding groups occurs (Katona and Beard 1990; Clapham *et al.* 1993; Palsbøll *et al.* 1997; Stevick *et al.* 1998). Some whalesusing eastern North Atlantic feeding areas migrate to the Cape Verde Islands (Reiner *et al.* 1996; Wenzel *et al.* 2009, Stevick *et al.* 2016), and some individuals have been recorded in both the Cape Verde Islands and the Caribbean (Stevick e*t al*. 2016). In the West Indies, the majority of whales are found in the waters of the Dominican Republic, notably on Silver Bank and Navidad Bank, and in Samana Bay (Balcomb and Nichols 1982; Whitehead and Moore 1982; Mattila *et al.* 1989, 1994). Humpback whales are also found at much lower densities throughout the remainder of the Antillean arc (Winn *et al.* 1975; Levenson and Leapley 1978; Price 1985; Mattila and Clapham 1989). Although recognition of 2 breeding areas for North Atlantic humpbacks is the prevailing model, our knowledge of breeding season distribution is far from complete (see Smith and Pike 2009, Stevick *et al.* 2016).

All whales from this stock do not migrate to the West Indies every winter, because significant numbers of animals are found in mid- and high-latitude regions at this time (Clapham *et al.* 1993; Swingle *et al.* 1993) and some individuals have been sighted repeatedly within the same winter season (Clapham *et al.* 1993; Robbins 2007). Acoustic recordings made within the Massachusetts Bay area detected some level of humpback song and non-song detections in almost all months, with two prominent periods, March through May and September through December (Clark and Clapham 2004, Vu *et al*. 2012, Murray *et al.* 2013). This pattern of acoustic occurrence, especially for song, confirms the presence of male humpback whales in the area (a mid-latitude feeding ground) during periods that bracket male occurrence in the Caribbean region, where singing is highest during winter months. A complementary pattern of humpback singer occurrence was observed during the January – May period in the deep-ocean region north of the Caribbean and to the east of Bermuda during April (Clark and Gagnon 2002). These acoustic observations from both coastal and deep-ocean regions support the conclusion that at least male humpbacks are seasonally distributed throughout broad regions of the western North Atlantic. In addition, photographic records from Newfoundland have shown a number of adult humpbacks remain there year-round, particularly on the island's north coast. In collaboration with colleagues in the French islands of St. Pierre and Miquelon, a new photographic catalogue and concurrent matching effort is being undertaken for this region (J. Lawson, DFO, pers. comm.).

Within the U.S. Atlantic EEZ, humpback whales have been sighted well away from the Gulf of Maine. Sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992 (Swingle *et al.* 1993). Wiley *et al.* (1995) reported that 38 humpback whale strandings occurred during 1985–1992 in the U.S. mid-Atlantic and southeastern states. Humpback whale strandings increased, particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature; in addition, the small size of many of these whales strongly suggested that they had only recently separated from their mothers. Wiley *et al.* (1995) concluded that these areas were becoming an increasingly important habitat for juvenile humpback whales and that anthropogenic factors may negatively impact whales in this area. There have also been a number of wintertime humpback sightings in coastal waters of the southeastern U.S. Whether the increased numbers of sightings represent a distributional change, or are simply due to an increase in sighting effort and/or whale abundance, is unknown. Other sightings of note include multiple humpbacks feeding off Long Island during July of 2016 (https://www.greateratlantic.fisheries.noaa.gov/mediacenter/2016/july/26_humpback_whales_visit_new_york.html, accessed 28 April 2017) and sightings during November-December 2016 near New York City (https://www.greateratlantic.fisheries.noaa.gov/mediacenter/2016/december/09_humans_and_humpbacks_of_new_york_2.html, accessed 28 April 2017).

A key question with regard to humpback whales off the southeastern and mid-Atlantic states is their population identity. This topic was investigated using fluke photographs of living and dead whales observed in the region (Barco *et al.* 2002). In this study, photographs of 40 whales (alive or dead) were of sufficient quality to be compared to catalogs from the Gulf of Maine (i.e., the closest feeding ground) and other areas in the North Atlantic. Of 21 live whales, 9 (43%) matched to the Gulf of Maine, 4 (19%) to Newfoundland, and 1 (4.8%) to the Gulf of St Lawrence. Of 19 dead humpbacks, 6 (31.6%) were known Gulf of Maine whales. Although the population composition of the mid-Atlantic is apparently dominated by Gulf of Maine whales, lack of photographic effort in Newfoundland makes it likely that the observed match rates under-represent the true presence of Canadian whales in the region. A new photographic catalog and concurrent matching effort is being undertaken for this region which may improve knowledge in this regard. Barco *et al.* (2002) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground used by humpbacks.

In New England waters, feeding is the principal activity of humpback whales, and their distribution in this region has been largely correlated to abundance of prey species, although behavior and bathymetry are factors influencing foraging strategy (Payne *et al.* 1986, 1990). Humpback whales are frequently piscivorous when in New England waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes. In the northern Gulf of Maine, euphausiids are also frequently taken (Paquet *et al.* 1997). Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern Gulf of Maine in the mid-1970s, with a concurrent decrease in humpback whale abundance in the northern Gulf of Maine. Humpback whales were densest over the sandy shoals in the southwestern Gulf of Maine favored by the sand lance during much of the late 1970s and early 1980s, and humpback distribution appeared to have shifted to this area (Payne *et al.* 1986). An apparent reversal began in the mid-1980s, and herring and mackerel increased as sand lance again decreased (Fogarty *et al.* 1991). Humpback whale abundance in the northern Gulf of Maine increased markedly during 1992–1993, along with a major influx of herring (P. Stevick, pers. comm.). Humpback whales were few in nearshore Massachusetts waters in the 1992–1993 summer seasons. They were more abundant in the offshore waters of Cultivator Shoal and on the Northeast Peak on Georges Bank and on Jeffreys Ledge; these latter areas are traditional locations of herring occurrence. In 1996 and 1997, sand lance and therefore humpback whales were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, when an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern Gulf of Maine, and humpbacks correspondingly continued to occupy this portion of the habitat, where they also fed on euphausiids (Wienrich *et al.* 1997). Diel patterns in humpback foraging behavior have been shown to correlate with diel patterns in sand lance behavior (Friedlaender *et al.* 2009).

In early 1992, a major research program known as the Years of the North Atlantic Humpback (YONAH) (Smith *et al.* 1999) was initiated. This was a large-scale, intensive study of humpback whales throughout almost their entire North Atlantic range, from the West Indies to the Arctic. During two primary years of field work, photographs for individual identification and biopsy samples for genetic analysis were collected from summer feeding areas and from the breeding grounds in the West Indies. Additional samples were collected from certain areas in other years. Results pertaining to the estimation of abundance and to genetic population structure are summarized below.

## POPULATION SIZE

### North Atlantic Population

The overall North Atlantic population (including the Gulf of Maine), derived from genetic tagging data collected by the YONAH project on the breeding grounds, was estimated to be 4,894 males (95% CI=3,374-7,123) and 2,804 females (95% CI=1,776-4,463) (Palsbøll *et al.* 1997). Because the sex ratio in this population is known to be even (Palsbøll *et al.* 1997), the excess of males is presumed a result of sampling bias, lower rates of migration among females, or sex-specific habitat partitioning in the West Indies; whatever the reason, the combined total is an underestimate of overall population size. Photographic mark-recapture analyses from the YONAH project provided an ocean-basin-wide estimate of 11,570 animals during 1992/1993 (CV=0.068, Stevick *et al.* 2003), and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 whales (CV=0.138, 95% CI=8,000 to 13,600) (Smith *et al.* 1999).

### Gulf of Maine stock - earlier estimates

Please see Appendix IV for earlier estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

### Gulf of Maine Stock - Recent surveys and abundance estimates

An abundance of 335 (CV=0.42) humpback whales was estimated from a line-transect survey conducted during June-August 2011 by ship and plane (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey and shallower than the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ. Both sighting platforms used a two-simultaneous-team data collection procedure, which allows estimation of abundance corrected for perception bias (Laake and Borchers, 2004). Estimation of abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). This estimate did not include the portion of the Scotian Shelf that is known to be part of the range used by Gulf of Maine humpback whales. These various line-transect surveys lack consistency in geographic coverage, and because of the mobility of humpback whales, pooling stratum estimates across years to produce a single estimate is not advisable. However, similar to an estimate that appeared in Clapham *et al.* (2003), J. Robbins (Center for Coastal Studies, pers. comm.) used photo-id evidence of presence (see Robbins 2009, 2010, 2011 for data description) to calculate the minimum number alive of catalogued individuals seen during the 2008 feeding season within the Gulf of Maine, or seen both before and after 2008, plus whales seen for the first time as non-calves in 2009. That procedure placed the minimum number alive in 2008 at 823 animals.

**Minimum Population Estimate**

For statistically-based estimates, 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 most recent line-transect survey, which did not include the Scotian Shelf portion of the stock, produced an estimate of abundance for Gulf of Maine humpback whales of 331 animals (CV=0.48) with a resultant minimum population estimate for this stock of 228 animals. The line-transect based Nmin is unrealistic because at least 500 uniquely identifiable individual whales from the GOM stock were seen during the calendar year of that survey and the actual population would have been larger because re-sighting rates of GOM humpbacks have historically been <1 (Robbins 2007). Using the minimum count from at least 2 years prior to the year of a stock assessment report allows time to resight whales known to be alive prior to and after the focal year. Thus, the minimum population estimate is set to the 2008 mark-recapture based count of 823.

Table 1. Summary of abundance estimates for Gulf of Maine humpback whales with month, year, and area covered during each abundance survey, and resulting abundance estimate ($N_{best}$) and coefficient of variation (CV). Note that the second row represents the results from an analysis of resights of individually identified animals.

| Month/Year | Type | $N_{best}$ | CV |
|---|---|---|---|
| Jun-Oct 2008 | Gulf of Maine and Bay of Fundy | 823 | 0 |
| Jun-Aug 2011 | Virginia to lower Bay of Fundy | 335 | 0.42 |

**Current Population Trend**

As detailed below, the most recent available data suggest that the Gulf of Maine humpback whale stock is characterized by a positive trend in size. This is consistent with an estimated average trend of 3.1% (SE=0.005) in the North Atlantic population overall for the period 1979–1993 (Stevick *et al.* 2003), although there are no feeding-area-specific estimates. The best available estimate of the average rate of increase for the West Indies breeding population [which includes the Gulf of Maine feeding stock] is 3.1% per year (SE= 0.005) for the period 1979–1993 (Stevick et al. 2003), although this estimate is now over 20 years old. An analysis of demographic parameters for the Gulf of Maine (Clapham *et al.* 2003) suggested a lower rate of increase than the 6.5% reported by Barlow and Clapham (1997), but results may have been confounded by distribution shifts.

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

Zerbini *et al.* (2010) reviewed various estimates of maximum productivity rates for humpback whale populations, and, based on simulation studies, they proposed that 11.8% be considered as the maximum rate at which the species could grow. Barlow and Clapham (1997), applying an interbirth interval model to photographic mark-recapture data, estimated the population growth rate of the Gulf of Maine humpback whale stock at 6.5% (CV=0.012). Maximum net productivity is unknown for this population, although a theoretical maximum for any humpback population can be calculated using known values for biological parameters (Brandão *et al.* 2000; Clapham *et al.* 2001). For the Gulf of Maine stock, data supplied by Barlow and Clapham (1997) and Clapham *et al.* (1995) give values of 0.96 for survival rate, 6 years as mean age at first parturition, 0.5 as the proportion of females, and 0.42 for annual pregnancy rate. From this, a maximum population growth rate of 0.072 is obtained according to the method described by Brandão *et al.* (2000). This suggests that the observed rate of 6.5% (Barlow and Clapham 1997) is close to the maximum for this stock.

Clapham *et al.* (2003) updated the Barlow and Clapham (1997) analysis using data from the period 1992 to 2000. The population growth estimate was either 0% (for a calf survival rate of 0.51) or 4.0% (for a calf survival rate of 0.875). Although uncertainty was not strictly characterized by Clapham *et al.* (2003), their work might reflect a decline in population growth rates from the earlier study period. More recent work by Robbins (2007) places apparent survival of calves at 0.664 (95% CI: 0.517-0.784), a value between those used by Barlow and Clapham (1997) and in addition found productivity to be highly variable and well less than maximum.

Despite the uncertainty accompanying the more recent estimates of observed population growth rate for the Gulf of Maine stock, the maximum net productivity rate was assumed to be 6.5% calculated by Barlow and

Clapham (1997) because it represents an observation greater than the default of 0.04 for cetaceans (Barlow *et al.* 1995) but is conservative in that it is well below the results of Zerbini *et al.* (2010).

**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 Gulf of Maine stock is 823 whales. The maximum productivity rate is 0.065. In the previous SAR, the recovery factor was 0.10 because this stock was listed as an endangered species under the Endangered Species Act. Due to the 2016 revision to the ESA listing of humpback whales, in which the West Indies Distinct Population Segment (of which the Gulf of Maine stock is a part) was identified as not warranting listing (81 FR 62259, September 8, 2016), the recovery factor is revised to 0.5, the default value for stocks of unknown status relative to OSP (Wade and Angliss 1997). Values other than the defaults for any stock should usually not be used without the approval of the regional Scientific Review Group, and scientific justification for the change should be provided in the Report (NMFS 2016). As the revision to the species' ESA listing occurred after the February 2016 Scientific Review Group meeting, the default recovery factor is applied here. The Atlantic SRG will review the recovery factor for this stock at its February 2017 meeting. PBR for the Gulf of Maine humpback whale stock is 13 whales.

**ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY**

For the period 2010 through 2014, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 9.05 animals per year. This value includes incidental fishery interaction records, 7.25; and records of vessel collisions, 1.8 (Table 2; Henry *et al.* 2016).

In contrast to stock assessment reports before 2007, these averages include humpback mortalities and serious injuries that occurred in the southeastern and mid-Atlantic states that could not be confirmed as involving members of the Gulf of Maine stock. In past reports, only events involving whales confirmed to be members of the Gulf of Maine stock were counted against the PBR. Starting in the 2007 report, we assumed whales were from the Gulf of Maine unless they were identified as members of another stock. At the time of this writing, no whale was identified as a member of another stock. These determinations may change with the availability of new information. Canadian records from the southern side of Nova Scotia were incorporated into the mortality and serious injury rates, to reflect the effective range of this stock as described above. For the purposes of this report, discussion is primarily limited to those records considered to be confirmed human-caused mortalities or serious injuries.

To better assess human impacts (both vessel collision and commercial fishery mortality and serious injury) there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies. The literature and review of records described here suggest that there are significant human impacts beyond those recorded in the data assessed for serious injury and mortality. For example, a study of entanglement-related scarring on the caudal peduncle of 134 individual humpback whales in the Gulf of Maine suggested that between 48% and 65% had experienced entanglements (Robbins and Mattila 2001). Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or no necropsy performed) represent 'lost data', some of which may relate to human impacts.

**Background**

As with right whales, human impacts (vessel collisions and entanglements) may be slowing recovery of the humpback whale population. Van der Hoop *et al.* (2013) reviewed 1762 mortalities and serious injuries recorded for 8 species of large whales in the Northwest Atlantic for the 40 years 1970–2009. Of 473 records of humpback whales, cause of death could be attributed for 203. Of the 203, 116 (57%) mortalities were caused by entanglements in fishing gear, and 31 (15%) were attributable to vessel strikes.

Robbins and Mattila (2001) reported that males were more likely to be entangled than females. Annually updated inferences made from scar prevalence and multistate models of GOM humpback whales that (1) younger animals are more likely to become entangled than adults, (2) juvenile scarring rates may be trending up, (3) maybe less than 10% of humpback entanglements are ever reported, and (4) 3 % of the population maybe dying annually as the result of entanglements (Robbins 2009, 2010, 2011, 2012). Humpback whale entanglements also occur in relatively high numbers in Canadian waters. Reports of interactions with fixed fishing gear set for groundfish around Newfoundland averaged 365 annually from 1979 to 1987 (range 174-813). An average of 50 humpback whale entanglements (range 26-66) was reported annually between 1979 and 1988, and 12 of 66 humpback whales entangled in 1988 died (Lien *et al.* 1988). A total of 965 humpbacks was reported entangled in fishing gear in Newfoundland and Labrador from 1979 to 2008 (Benjamins *et al.* 2012). Volgenau *et al.* (1995) reported that in

Newfoundland and Labrador, cod traps caused the most entanglements and entanglement mortalities (21%) of humpbacks between 1979 and 1992. They also reported that gillnets were the primary cause of entanglements and entanglement mortalities (20%) of humpbacks in the Gulf of Maine between 1975 and 1990. In more recent times, following the collapse of the cod fishery, groundfish gillnets for other fish species and crab pot lines have been the most common sources of humpback entanglement in Newfoundland. Since the crab pot fishery is primarily an offshore activity on the Grand Banks, these entanglements are hard to respond to and are likely underreported. One humpback whale was reported released alive (status unknown) from a herring weir off Grand Manan in 2009 (H. Koopman, UNC Wilmington, pers. comm.). In U.S. waters, Johnson *et al.* (2005) found 40% of humpback entanglements were in trap/ pot gear and 50% were in gillnet, but sample sizes were small and much uncertainty still exists about the frequency of certain gear types involved in entanglement.

Wiley *et al.* (1995) reported that serious injuries attributable to ship strikes are more common and probably more serious than those from entanglements, but this claim is not supported by more recent analysis. Non-lethal interactions with gear are extremely common (see Robbins 2010, 2011, 2012) and recent analysis suggests entanglement serious injuries and mortalities are more common than ship strikes (van der Hoop *et al.* 2013). Furthermore, in the NMFS records for 2010 through 2014, there are only 9 reports of serious injuries and mortalities as a result of collision with a vessel and 40 records of injuries (prorated or serious) and mortalities attributed to entanglement. Because it has never been shown that serious injuries and mortalities related to ships or to fisheries interactions are equally detectable, it is unclear as to which human source of mortality is more prevalent. A major aspect of vessel collision that will be cryptic as a serious injury is blunt trauma, where when lethal it is usually undetectable from an external exam (Moore *et al.* 2013). No whale involved in the recorded vessel collisions had been identified as a member of a stock other than the Gulf of Maine stock at the time of this writing (Henry *et al.* 2016).

**Fishery-Related Serious Injuries and Mortalities**

A description of fisheries is provided in Appendix III. Two mortalities were observed in the pelagic drift gillnet fishery, one in 1993 and the other in 1995. In winter 1993, a juvenile humpback was observed entangled and dead in a pelagic drift gillnet along the 200-m isobath northeast of Cape Hatteras. In early summer 1995, a humpback was entangled and found dead in a pelagic drift gillnet on southwestern Georges Bank. Additional reports of mortality and serious injury, as well as description of total human impacts, are contained in records maintained by NMFS. A number of these records (11 entanglements involving lobster pot/trap gear) from the 1990–1994 period were the basis used to reclassify the lobster fishery (62 FR 33, Jan. 2, 1997). Large whale entanglements are rarely observed during fisheries sampling operations. However, during 2008, 3 humpback whales were observed as incidental bycatch: 2 in gillnet gear (1 no serious injury; 1 undetermined) and 1 in a purse seine (released alive), in 2011 a humpback was caught on an observed gillnet trip (disentangled and released free of gear; Henry *et al.* 2016), and in 2012 there was an observed interaction with a humpback whale in mid-Atlantic gillnet gear (non-serious injury). A recent review (Cassoff *et al*. 2011) describes in detail the types of injuries that baleen whales, including humpbacks, suffer as a result of entanglement in fishing gear.

For this report, the records of dead, injured, and/or entangled humpbacks (found either stranded or at sea) for the period 2010 through 2014 were reviewed. When there was no evidence to the contrary, events were assumed to involve members of the Gulf of Maine stock. While these records are not statistically quantifiable in the same way as observer fishery records, they provide some indication of the minimum frequency of entanglements. Specifically to this stock, if the calculations of Robbins (2011, 2012) are reasonable then the 3% mortality due to entanglement that she calculates equates to a minimum average rate of 25, which is nearly 10 times PBR.

Table 2. Confirmed human-caused mortality and serious injury records of Humpback Whales (*Megaptera novaeangliae*) where the cause was assigned as either an entanglement (EN) or a vessel strike (VS): 2010–2014 [a]

| Date[b] | Injury Determination | ID | Location[b] | Assigned Cause | Value against PBR[c] | Country[d] | Gear Type[e] | Description |
|---|---|---|---|---|---|---|---|---|
| 3/7/2010 | Serious Injury | - | off Ponte Vedra Beach, FL | EN | 1 | XU | NR | Constricting body & flipper wraps. May have |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | shed some or all of gear, but severe health decline: emaciated, heavy cyamid load. |
| 3/13/2010 | Mortality | - | Ocean City Inlet, MD | VS | 1 | US | - | Skull fractures w/ associated hemorrhaging |
| 5/5/2010 | Serious Injury | - | off Northampton, VA | EN | 1 | XU | NR | Wrap around fluke blades near insertion & trailing gear. Gear likely to become constricting as animal grows. |
| 5/8/2010 | Mortality | - | off Point Judith, RI | EN | 1 | US | GN | Evidence of constricting gear w/ associated hemorrhaging. Fluid filled lungs. |
| 5/15/2010 | Mortality | - | Hatteras Inlet, NC | EN | 1 | XU | NP | Live stranding - euthanized. Necrotic infected wounds at base of flukes & chronic abrasions on head. |
| 5/28/2010 | Mortality | - | off Martha's Vineyard, MA | EN | 1 | XU | GU | Evidence of entanglement w/ associated bruising & edema. |
| 6/10/2010 | Mortality | - | Jones Beach State Park, NY | VS | 1 | US | - | Extensive hemorrhage & edema on right dorsal lateral surface. |
| 7/4/2010 | Mortality | - | off Ocean City Inlet, MD | VS | 1 | US | - | Extensive hemorrhage & edema to left lateral area. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7/26/2010 | Prorated Injury | - | off Chatham, MA | EN | 0.75 | XU | NR | Full configuration unknown. |
| 8/13/2010 | Serious Injury | - | off Orleans, MA | EN | 1 | US | PT | Partial disentanglement, but remaining head wrap likely to become constricting. |
| 8/20/2010 | Serious Injury | Chili | off Provincetown, MA | EN | 1 | XU | NR | Embedded wraps;health decline: thin, moderate cyamids, sloughing skin, fluke discoloration |
| 9/10/2010 | Prorated Injury | - | off White Head Island, New Brunswick | EN | 0.75 | XC | NR | Full configuration unknown. |
| 10/2/2010 | Prorated Injury | - | off Provincetown, MA | EN | 0.75 | XU | NR | Full configuration unknown. Unable to confirm if a resight of 8/20/10 event. |
| 11/27/2010 | Mortality | - | off Grand Manan Island, New Brunswick | EN | 1 | XC | NR | Evidence of constricting wraps on fluke, peduncle, & pectoral |
| 12/23/2010 | Serious Injury | - | off Port Everglades Inlet, FL | EN | 1 | XU | NP | Evidence of recent constricting entanglement & severe health decline. |
| 1/7/2011 | Serious Injury | - | off Oregon Inlet, NC | EN | 1 | US | GN | Extensive entanglement w/ netting covering majority of body including head, blowholes, & flukes. Immobile & drifting. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2/1/2011 | Serious Injury | EKG | off Bar Harbor, ME | EN | 1 | US | NR | Anchored. Cuts were made to gear but whale remained anchored. |
| 3/7/2011 | Mortality | - | Thorofare Bay, NC | VS | 1 | US | - | Live stranded w/ 8 deep lacerations across back. Euthanized. |
| 4/11/2011 | Prorated Injury | - | off Rockport, MA | EN | 0.75 | XU | NR | Full configuration unknown. |
| 5/5/2011 | Mortality | - | Little Compton, RI | VS | 1 | US | - | Hemorrhaging at left jaw associated w/ blunt trauma. |
| 5/27/2011 | Mortality | - | Island Beach State Park, NJ | VS | 1 | US | - | 5 broken vertebral processes along left side w/ associated hemorrhaging. |
| 5/30/2011 | Prorated Injury | - | off Orleans, MA | EN | 0.75 | XU | NR | Full configuration unknown. |
| 7/2/2011 | Serious Injury | - | off Provincetown, MA | EN | 1 | XU | NP | Young whale. Missing flukes attributed to chronic entanglement. Laceration due to VS appears minor. Significant health decline: emaciated, swimming by use of pectorals only |
| 7/9/2011 | Prorated Injury | - | off Monomoy Island, MA | EN | 0.75 | XU | NR | Full configuration unknown. |
| 7/10/2011 | Prorated Injury | - | off Monomoy Island, MA | EN | 0.75 | XU | NR | Report of two entangled whales but could not confirm that both were entangled. |

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| | | | | | | | | Full configuration unknown. |
| 7/21/2011 | Prorated Injury | - | off Oregon Inlet, NC | EN | 0.75 | XU | NR | Full configuration unknown. |
| 10/10/2011 | Serious Injury | Clutter | off Grand Manan Island, New Brunswick | EN | 1 | XC | NR | Embedded wraps at fluke insertion. |
| 4/29/2012 | Serious Injury | - | off Chatham, MA | EN | 1 | US | NR | SI based on description of body position which indicates anchored |
| 7/29/2012 | Serious Injury | - | off Gloucester, MA | EN | 1 | XU | NR | Calf w/ line cutting into peduncle |
| 8/4/2012 | Serious Injury | Aphid | off Provincetow n, MA | EN | 1 | XU | NR | Line exiting both sides of mouth, under flippers, twisting together aft of the dorsal fin & trailing 75 ft past flukes; no wraps. Health decline: thin w/ graying skin. |
| 8/21/2012 | Prorated Injury | 2011 Calf of Wizard | off Provincetow n, MA | EN | 0.75 | XU | MF | Full configuration unknown |
| 8/24/2012 | Serious Injury | Forceps | off Provincetow n, MA | EN | 1 | US | NR | Closed, possibly weighted, bridle w/ large tangle of line just above left eye. SI due to odd behavior & apparent difficulty staying at the surface. |
| 04/03/2013 | Mortality | - | off Ft Story, VA | VS | 1 | US | - | Fractured orbitals & ribs w/ |

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| | | | | | | | | associated bruising |
| 09/13/2013 | Mortality | - | York River, VA | VS | 1 | US | - | 6 lacerations penetrate into muscle w/ associated hemorrhaging |
| 09/16/2013 | Prorated Injury | - | off Chatham, MA | EN | 0.75 | XU | NR | Partial disentanglement; original & final configurations unknown |
| 09/28/2013 | Mortality | - | off Saltaire, NY | EN | 1 | XU | GU | Embedded line in mouth w/ associated hemorrhaging & necrosis; evidence of constriction at pectorals, peduncle & fluke w/ associated hemorrhaging; emaciated |
| 10/01/2013 | Mortality | - | Buzzards Bay, MA | EN | 1 | US | NP | Evidence of underwater entrapment & subsequent drowning. |
| 10/04/2013 | Serious Injury | - | off Chatham, MA | EN | 1 | XU | NR | Full configuration unknown, but evidence of health decline: emaciation & pale skin |
| 06/02/14 | Prorated Injury | - | 15 mi E of Monomoy Island, MA | EN | 0.75 | XU | | Free-swimming with buoy and highflier trailing 100ft aft of flukes. Attachment point(s) unknown. Unable to confirm if resighted on 21Jun2014. |

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| 06/21/14 | Prorated Injury | | 5 mi E of Gloucester, MA | EN | 0.75 | XU | | Free-swimming trailing a buoy and possibly another buoy/highflier aft. Attachment point(s) unknown. Unable to confirm if this is a resight of 02Jun2014. |
| 07/18/14 | Serious Injury | | Provincetown Harbor, MA | EN | 1 | XU | | Free-swimming, trailing short amount of line from left side of mouth. No other gear noted, but evidence of previously more complicated, constricting entanglement. Current configuration deemed non-life threatening. Unsuccessful disentanglement attempt. In poor condition - emaciated with some cyamids. No resights |
| 09/04/14 | Serious Injury | 4001 | 8 mi SE of Grand Manan, NB | EN | 1 | XC | | Free-swimming with constricting rostrum wrap. Remaining configuration unknown. No resights post Oct 2014. |

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| 09/11/14 | Mortality | Spinnaker | 10 nm SE of Frenchboro, ME | EN | 1 | XU | | Free-swimming with gillnet gear. Found anchored on 12Sep2014. Gillnet panel lodged in mouth and tightly wrapping forward part of body. Panel entangled in pots with 20+ wraps of pot lines around flukes and peduncle. Mostly disentangled--left with short section of gillnet in mouth expecting to shed. Animal entangled again (14May2015 - anchored and disentangled). Carcass found 11Jun2015. Necropsy revealed gillnet from 2014 entanglement embedded deep into the maxilla and through the vomer. Bone had started to grow around the line. Gillnet is unknown origin. Pot/trap is US gear. |

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| 09/17/14 | Serious Injury | 3279 | 10 mi SE of Grand Manan, NB | EN | 1 | XC | Unknown | Free-swimming with heavy, green line over head cutting into nares. Remaining configuration unknown. In poor overall condition: heavy cyamids on head and blowholes. Left blowhole appears compromised. No resights. |
| 09/20/14 | Prorated Injury | NYC0010 | off Rockaway Beach, Long Island, NY | EN | .75 | US | | Free-swimming with netting and rope with floats wrapping flukes. Entanglement noticed during photo processing. Full configuration unknown. No resights. |
| 10/01/14 | Prorated Injury | | 15 mi E of Metompkin Inlet, VA | EN | .75 | US | | Free-swimming whale with line & netting on left fluke blade. Gear appeared heavy. Full configuration unknown. No resights. |
| 11/25/14 | Mortality | | Miacomet Beach, Nantucket, MA | VS | 1 | XU | | Emaciated carcass. Bruising & edema associated with skull fractures. Proximate COD=renal parasitism |

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| | | | | | | | | and consequent failure. Ultimate COD=blunt trauma from vessel strike. |
| 12/15/14 | Prorated Injury | | 8.5 nm S of Grand Manan, NB | EN | .75 | XC | PT | Fisherman found animal entangled in trawl. Grappled line, animal dove. Upon surfacing, appeared free of gear, but unable to confirm gear free. Original and final configuration unknown. |
| 12/25/14 | Mortality | Triomphe | Little Cranberry Island, ME | EN | 1 | XU | | Fresh carcass with evidence of extensive constricting entanglement. No necropsy, but robust body condition and histopatholog y results of samples support EN as COD. |
| Five-year averages | | Shipstrike (US/CN/XU/XC) | | | 1. 80 ( 1.60/ 0.00/ 0.20/ 0.00) | | | |
| | | Entanglement (US/CN/XU/XC) | | | 7.25 ( 1.7/ 0.00/ 4.545/ 1.10) | | | |
| a. For more details on events please see Henry *et al.* 2016. | | | | | | | | |
| b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured. | | | | | | | | |
| c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012) | | | | | | | | |
| d. CN=Canada, US=United States, XC=Unassigned 1st sight in CN, XU=Unassigned 1st sight in US | | | | | | | | |
| e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir | | | | | | | | |

**Other Mortality**

Between November 1987 and January 1988, at least 14 humpback whales died after consuming Atlantic mackerel containing a dinoflagellate saxitoxin (Geraci *et al.* 1989). The whales subsequently stranded or were recovered in the vicinity of Cape Cod Bay and Nantucket Sound, and it is highly likely that other unrecorded mortalities occurred during this event. During the first six months of 1990, seven dead juvenile (7.6 to 9.1 m long) humpback whales stranded between North Carolina and New Jersey. The significance of these strandings is unknown.

Between July and September 2003, an Unusual Mortality Event (UME) that included 16 humpback whales was invoked in offshore waters of coastal New England and the Gulf of Maine. Biotoxin analyses of samples taken from some of these whales found saxitoxin at very low/questionable levels and domoic acid at low levels, but neither were adequately documented and therefore no definitive conclusions could be drawn. Seven humpback whales were considered part of a large whale UME in New England in 2005. Twenty-one dead humpback whales found between 10 July and 31 December 2006 triggered a humpback whale UME declaration. Causes of these UME events have not been determined.

**STATUS OF STOCK**

NMFS conducted a global status review of humpback whales (Bettridge *et al*. 2015) and recently revised the ESA listing of the species (81 FR 62259, September 8, 2016). The distinct population segments (DPSs) established in the final rule that occur in waters under the jurisdiction of the United States do not necessarily equate to the existing MMPA stocks. NMFS is evaluating the stock structure of humpback whales under the MMPA, but no changes to current stock structure are presented at this time. As noted within the humpback whale ESA-listing final rule, in the case of a species or stock that achieved its depleted status solely on the basis of its ESA status, such as the humpback whale, the species or stock would cease to qualify as depleted under the terms of the definition set forth in MMPA Section 3(1) if the species or stock is no longer listed as threatened or endangered. The final rule indicated that until the stock delineations are reviewed in light of the DPS designations, NMFS would consider stocks that do not fully or partially coincide with a listed DPS as not depleted for management purposes. Therefore, the Gulf of Maine stock is considered not depleted because it does not coincide with any ESA-listed DPS. The detected level of U.S. fishery-caused mortality and serious injury derived from the available records, which is likely biased low, is more than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant or approaching a zero mortality and serious injury rate. This is not a strategic stock because the average annual human-related mortality and serious injury does not exceed PBR.

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# FIN WHALE (*Balaenoptera physalus*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The Scientific Committee of the International Whaling Commission (IWC) has proposed stock boundaries for North Atlantic fin whales. Fin whales off the eastern United States, Nova Scotia, and the southeastern coast of Newfoundland are believed to constitute a single stock under the present IWC scheme (Donovan 1991). Although the stock identity of North Atlantic fin whales has received much recent attention from the IWC, current understanding of stock boundaries remains uncertain. The existence of a subpopulation structure was suggested by local depletions that resulted from commercial overharvesting (Mizroch *et al.* 1984).

A genetic study conducted by Bérubé *et al.* (1998) using both mitochondrial and nuclear DNA provided strong support for an earlier population model proposed by Kellogg (1929) and others. This postulates the existence of several subpopulations of fin whales in the North Atlantic and Mediterranean with limited gene flow among them. Bérubé *et al.* (1998) also proposed that the North Atlantic population showed recent divergence due to climatic changes (i.e., postglacial expansion), as well as substructuring over even relatively short distances. The genetic data are consistent with the idea that different subpopulations use the same feeding ground, a hypothesis that was also originally proposed by Kellogg (1929). More recent genetic studies have called into question conclusions drawn from early allozyme work (Olsen *et al.* 2014) and North Atlantic fin whales show a very low rate of genetic diversity throughout their range excluding the Mediterranean (Pampoulie *et al*. 2008).

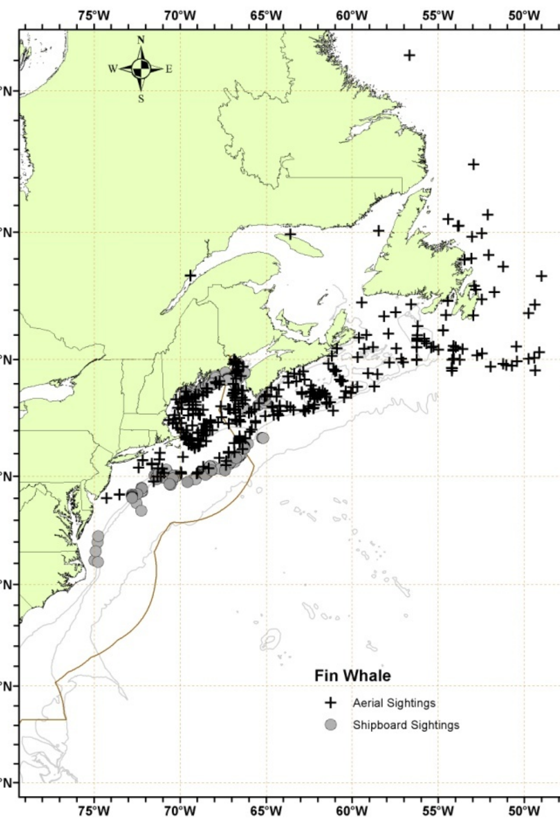


**Figure 1**.*Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011 and DFO's 2007 TNASS survey. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

Fin whales are common in waters of the U. S. Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward (Figure 1). In a recent globally-scaled review of sightings data, Edwards *et al.* (2015) found evidence to confirm the presence of fin whales in every season throughout much of the US EEZ north of 35º. Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CETAP 1982) between Cape Hatteras and Nova Scotia during 1978–1982. While much remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region fin whales are the dominant large cetacean species during all seasons, having the largest standing stock, the largest food requirements, and therefore the largest influence on ecosystem processes of any cetacean species (Hain *et al.* 1992; Kenney *et al.* 1997). Acoustic detections of fin whale singers augment and confirm these visual sighting conclusions for males. Recordings from Massachusetts Bay, New York bight, and deep-ocean areas detected some level of fin whale singing from September through June (Watkins et al. 1987, Clark and Gagnon 2002, Morano et al. 2012). These acoustic observations from both coastal and deep-ocean regions support the conclusion that male fin whales are broadly distributed throughout the western North Atlantic for most of the year.

New England waters represent a major feeding ground for fin whales. There is evidence of site fidelity by females, and perhaps some segregation by sexual, maturational, or reproductive class in the feeding area (Agler *et* *al.* 1993). Seipt *et al.* (1990) reported that 49% of identified fin whales sighted on the Massachusetts Bay area feeding grounds were resighted within the same year, and 45% were resighted in multiple years. The authors suggested that fin whales on these grounds exhibited patterns of seasonal occurrence and annual return that in some respects were similar to those shown for humpback whales. This was reinforced by Clapham and Seipt (1991), who showed maternally-directed site fidelity for fin whales in the Gulf of Maine.

Hain *et al.* (1992), based on an analysis of neonate stranding data, suggested that calving takes place during October to January in latitudes of the U.S. mid-Atlantic region; however, it is unknown where calving, mating, and wintering occur for most of the population. Results from the Navy's SOSUS program (Clark 1995) indicated a substantial deep-ocean distribution of fin whales. It is likely that fin whales occurring in the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions. However, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support in the data; in the North Pacific, year-round monitoring of fin whale calls found no evidence for large-scale migratory movements (Watkins *et al.* 2000).

## POPULATION SIZE

The best abundance estimate available for the western North Atlantic fin whale stock is 1,618 (CV=0.33). This is the estimate derived from the 2011 NOAA shipboard surveys and is considered best because it represents the only current data. It is likely that the available estimate underestimates this stock's abundance because much of the stock's range was not included in the surveys upon which the estimate is based.

### Earlier abundance estimates

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for the determination of a current PBR.

### Recent surveys and abundance estimates

An abundance estimate of 1,595 (CV=0.33) fin whales was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour, through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of North Carolina to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a double-platform data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the multiple-covariate distance sampling (MCDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).The abundance estimates of fin whales include a percentage of the estimate of animals identified as fin/sei whales (the two species being sometimes hard to distinguish).The percentage used is the ratio of positively identified fin whales to the total number of positively identified fin whales and positively identified sei whales; the CV of the abundance estimate includes the variance of the estimated fraction.

An abundance estimate of 23 (CV=0.87) fin whales was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida. This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed two independent visual teams searching with 25× bigeye binoculars. A total of 4,445 km of tracklines was surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break with generally lower sighting rates over the continental slope. Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Table 1. Summary of recent abundance estimates for western North Atlantic fin whales with 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 2011 | Central Virginia to lower Bay of Fundy | 1,595 | 0.33 |

| | | | |
|---|---|---|---|
| Jun-Aug 2011 | Central Florida to Central Virginia | 23 | 0.76 |
| Jun-Aug 2011 | Central Florida to lower Bay of Fundy (COMBINED) | 1,618 | 0.33 |

### 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 fin whales is 1,618 (CV=0.33). The minimum population estimate for the western North Atlantic fin whale is 1,234.

### 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

Current and maximum net productivity rates are unknown for this stock. Based on photographically identified fin whales, Agler *et al.* (1993) estimated that the gross annual reproduction rate was 8%, with a mean calving interval of 2.7 years.

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 is 1,234. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.10 because the fin whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic fin whale is 2.5. Because there is a strong likelihood the abundance estimate used to calculate PBR was biased low due to incomplete coverage of the stock's range, it is therefore likely that this PBR calculation is low.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2010 through 2014, the minimum annual rate of human-caused mortality and serious injury to fin whales was 3.8 per year. This value includes incidental fishery interaction records, 1.8 (0.2 U.S./0.8 Canadian/0.8 unknown but first reported in U.S. waters); and records of vessel collisions, 2.0 (all U.S.) (Table 2; Henry *et al.* 2016). Annual rates calculated from detected mortalities should not be considered an unbiased representation of human-caused mortality, but they represent a definitive lower bound. Detections are haphazard and not the result of a designed sampling scheme. As such they represent a minimum estimate of human-caused mortality which is almost certainly biased low.

### Fishery-Related Serious Injury and Mortality

No confirmed fishery-related mortalities or serious injuries of fin whales have been reported in the NMFS Sea Sampling bycatch database. A review of the records of stranded, floating, or injured fin whales for the period 2010 through 2014 on file at NMFS found 4 records with substantial evidence of fishery interactions causing mortality (Henry *et al.* 2016). Serious injury determinations from non-fatal fishery interaction records yielded a value of 5.0 over five years, for an annual average of 1.0 (Henry *et al.* 2016). The resultant estimated minimum annual rate of serious injury and mortality from fishery interactions for this fin whale stock is 1.8. These records are not statistically quantifiable in the same way as the observer fishery records, and they almost surely undercount entanglements for the stock.

Table 2a. Confirmed human-caused mortality and serious injury records of fin whales (*Balaenoptera physalus*) first reported in U.S. waters or attributed to U.S. where the cause was assigned as either an entanglement (EN) or a vessel strike (VS): 2010–2014[a]

| Date[b] | Injury Determination | ID | Location[b] | Assigned Cause | Value against PBR[c] | Country[d] | Gear Type[e] | Description |
|---|---|---|---|---|---|---|---|---|
| 3/18/10 | Mortality | - | South Delaware Bay Beach, DE | VS | 1 | US | - | Fractured skull w/ associated hemorrhaging.Abrasion mid-dorsal consistent w/ being folded over the bow of a ship. |
| 9/3/10 | Mortality | - | Cape Henlopen State Park, DE | VS | 1 | US | - | Large laceration & vertebral fractures w/ associated hemorrhaging. |
| 1/1/11 | Mortality | - | off Portland, ME | EN | 1 | XU | NP | Fresh carcass w/ evidence of constricting gear. |
| 6/5/11 | Mortality | - | off Long Branch, NJ | VS | 1 | US | - | Extensive hemorrhage & soft tissue damage to the dorsal & right lateral thoracic region. |
| 9/21/11 | Mortality | - | off Atlantic City, NJ | EN | 1 | US | NP | Fresh carcass w/ evidence of extensive entanglement. |
| 1/23/12 | Mortality | - | Ocean City, NJ | VS | 1 | US | - | Hemorrhaging along right, midlateral surface. |
| 2/19/12 | Mortality | - | Norfolk, VA | VS | 1 | US | - | Deep laceration on head. Skeletal fractures of rostrum and vertebrae. Extensive hemorrhaging. |
| 7/16/12 | Prorated Injury | - | off Portland, ME | EN | 0.75 | XU | NR | Full configuration unknown. |
| 7/30/12 | Prorated Injury | 0631 | off Portsmouth, NH | EN | 0.75 | XU | NR | Full configuration unknown. |
| 8/10/12 | Mortality | - | Hampton Bays, NY | VS | 1 | US | - | Extensive bruising along right lateral and ventral aspects. |
| 10/7/12 | Mortality | - | Boston Harbor, MA | VS | 1 | US | - | Deep mid-line impression with associated hemorrhaging consistent with being folded across bow of ship. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1/13/13 | Mortality | - | East Hampton, NJ | VS | 1 | US | - | Fracturing of left cranium with associated hematoma |
| 4/12/14 | Mortality | - | Port Elizabeth, NJ | VS | 1 | US | - | Fresh carcass on bow of vessel. Large external abrasions w/ associated hemorrhage and skeletal fractures along right side. |
| 6/23/14 | Prorated Injury | | off Chatham, MA | EN | 0.75 | XU | NR | Free-swimming, trailing 200ft of line. Attachment point(s) unknown. No resights. |
| 8/20/14 | Prorated Injury | | off Provincetown , MA | EN | 0.75 | XU | NR | Free-swimming, trailing buoy & 200ft of line aft of flukes. Attachment point(s) unknown. No resights. |
| 10/5/14 | Mortality | - | off Manasquan, NJ | VS | 1 | US | - | Large area of hemorrhage along dorsal, ventral, and right lateral surfaces consistent with blunt force trauma. |
| Five-year averages | | Shipstrike (US/ XU) | | | 2.0 ( 2.0/ 0.0) | | | |
| | | Entanglement (US/ XU) | | | 1.0 ( 0.2/ 0.8) | | | |
| a. For more details on events please see Henry *et al.* 2016. | | | | | | | | |
| b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured. | | | | | | | | |
| c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012) | | | | | | | | |
| d. US=United States, XU=Unassigned 1st sight in U.S. | | | | | | | | |
| e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir | | | | | | | | |

Table 2b. Confirmed human-caused mortality and serious injury records of fin whales (*Balaenoptera physalus*) first reported in Canadian waters or attributed to Canada where the cause was assigned as either an entanglement (EN) or a vessel strike (VS): 2010–2014[a]

| Date[b] | Injury Determination | ID | Location[b] | Assigned Cause | Value against PBR[c] | Country[d] | Gear Type[e] | Description |
|---|---|---|---|---|---|---|---|---|
| 7/2/11 | Serious Injury | F100 | Gulf of St. Lawrence | EN | 1 | CN | PT | Deep lacerations at peduncle. Unconfirmed if gear free. |
| 7/24/11 | Mortality | - | Cheticamp, Nova Scotia | EN | 1 | CN | NP | Fresh carcass w/ evidence of extensive entanglement. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6/6/13 | Serious Injury | Capitaine Crochet | St. Lawrence Marine Park, Quebec | EN | 1 | CN | PT | Pot resting on upper jaw w/ bridle lines embedding in mouth; health decline: emaciation |
| 5/13/14 | Mortality | - | Rocky Harbour, NL | EN | 1 | CN | PT | Fresh carcass hog-tied in gear. |
| Five-year averages | | Shipstrike (CN/XC) | | | 0 | | | |
| | | Entanglement (CN/XC) | | | 0.8 (0.8/ 0.0) | | | |
| a. For more details on events please see Henry *et al.* 2016. | | | | | | | | |
| b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured. | | | | | | | | |
| c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012) | | | | | | | | |
| d. CN=Canada, XC=Unassigned 1st sight in CN | | | | | | | | |
| e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir | | | | | | | | |

**Other Mortality**

After reviewing NMFS records for 2010 through 2014, 10 were found that had sufficient information to confirm the cause of death as collisions with vessels (Table 2; Henry *et al.* 2016). These records constitute an annual rate of serious injury or mortality of 2.0 fin whales from vessel collisions.

**STATUS OF STOCK**

This is a strategic stock because the fin whale is listed as an endangered species under the ESA. The total level of human-caused mortality and serious injury is unknown. NMFS records represent coverage of only a portion of the area surveyed for the population estimate for the stock. The total U.S. fishery-related mortality and serious injury for this stock derived from the available records is likely biased low and is not less than 10% of the calculated PBR. Therefore entanglement rates cannot be considered insignificant and approaching a zero mortality and serious injury rate. The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trend for fin whales.

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# SEI WHALE (*Balaenoptera borealis borealis*): Nova Scotia Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Mitchell and Chapman (1977) reviewed the sparse evidence on stock identity of northwestern Atlantic sei whales, and suggested two stocks—a Nova Scotia stock and a Labrador Sea stock. The range of the Nova Scotia stock includes the continental shelf waters of the northeastern U.S., and extends northeastward to south of Newfoundland. The Scientific Committee of the International Whaling Commission (IWC), while adopting these general boundaries, noted that the stock identity of sei whales (and indeed all North Atlantic whales) was a major research problem (Donovan 1991). In the absence of evidence to the contrary, the proposed IWC stock definition is provisionally adopted, and the "Nova Scotia stock" is used here as the management unit for this stock assessment. The IWC boundaries for this stock are from the U.S. east coast to Cape Breton, Nova Scotia, thence east to longitude 42$^{o}$ W. Recent telemetry evidence offers some support that sei whales foraging in the Labrador Sea winter in the Azores and constitute a separate stock (Prieto *et al*. 2014).

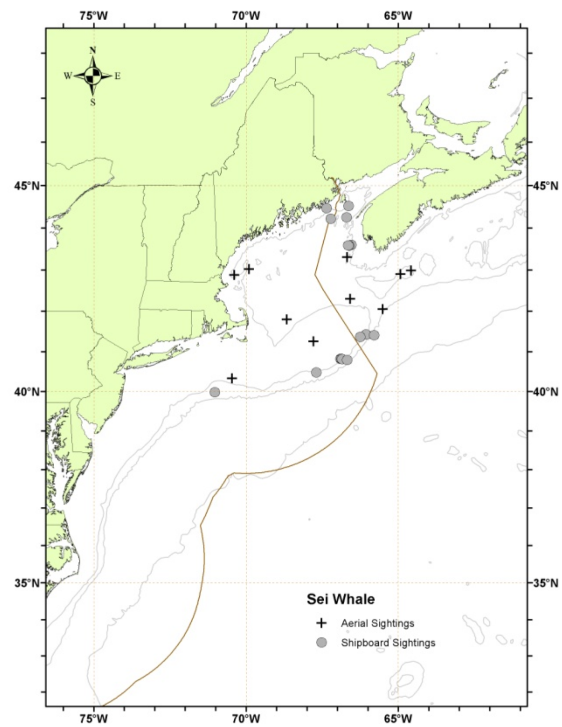


**Figure 1**. *Distribution of sei whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

Indications are that, at least during the feeding season, a major portion of the Nova Scotia sei whale stock is centered in northerly waters, perhaps on the Scotian Shelf (Mitchell and Chapman 1977). The southern portion of the species' range during spring and summer includes the northern portions of the U.S. Atlantic Exclusive Economic Zone (EEZ)—the Gulf of Maine and Georges Bank. Spring is the period of greatest abundance in U.S. waters, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (CETAP 1982). NMFS aerial surveys since 1999 have found concentrations of sei and right whales along the northern edge of Georges Bank in the spring. The sei whale is often found in the deeper waters characteristic of the continental shelf edge region (Hain *et al.* 1985), and NMFS aerial surveys found substantial numbers of sei whales in this region, in particular south of Nantucket, in the spring of 2001. Similarly, Mitchell (1975) reported that sei whales off Nova Scotia were often distributed closer to the 2,000-m depth contour than were fin whales.

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into shallower, more inshore waters. Although known to eat fish in other oceans, sei whales (like right whales) are largely planktivorous, feeding primarily on euphausiids and copepods (Flinn *et al.* 2002). A review of prey preferences by Horwood (1987) showed that, in the North Atlantic, sei whales seem to prefer copepods over all other prey species. In Nova Scotia sampled stomachs from captured sei whales showed a clear preference for copepods between June and October, and euphausiids were taken only in May and November (Mitchell 1975). Sei whales are reported in some years in more inshore locations, such as the Great South Channel (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (R.D. Kenney, pers. comm.; Payne *et al.* 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of 1986 (Schilling *et al.* 1993). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide (Jonsgård and Darling 1977).

Based on analysis of records from the Blandford, Nova Scotia, whaling station, where 825 sei whales were taken between 1965 and 1972, Mitchell (1975) described two "runs" of sei whales, in June–July and in September–October. He speculated that the sei whale stock migrates from south of Cape Cod and along the coast of eastern Canada in June and July, and returns on a southward migration again in September and October; however, such a migration remains unverified.

## POPULATION SIZE

The summer 2011 abundance estimate of 357 (CV=0.52) is considered the best available for the Nova Scotia stock of sei whales. However, this estimate must be considered conservative because all of the known range of this stock was not surveyed, because it did not include an availability-bias correction for animals missed while submerged, and because of uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas.

### Earlier abundance estimates

Please see appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for determination of the current PBR.

### Recent surveys and abundance estimates

An abundance estimate of 357 (CV=0.52) sei whales was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters from north of New Jersey from the coastline to the 100-m depth contour, through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of Virginia to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a double-platform data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the multiple-covariate distance sampling (MCDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). The abundance estimates of sei whales include a percentage of the estimate of animals identified as fin/sei whales (the two species being sometimes hard to distinguish). The percentage used is the ratio of positively identified sei whales to the total of positively identified fin whales and positively identified sei whales; the CV of the abundance estimate includes the variance of the estimated fraction. Although this is the best estimate available for this stock, it should be noted that the abundance survey from which it was derived excluded waters off the Scotian Shelf, an area encompassing a large portion of the stated range of the stock.

Table 1. Summary of recent abundance estimates for Nova Scotia sei whales with 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 2011 | Central Virginia to lower Bay of Fundy | 357 | 0.52 |

### 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 Nova Scotia stock sei whales is 357 (CV=0.52). The minimum population estimate is 236.

### 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

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations 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 is 236. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.10 because the sei whale is listed as endangered under the Endangered Species Act (ESA). PBR for the Nova Scotia stock of the sei whale is 0.5.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2010 through 2014, the minimum annual rate of human-caused mortality and serious injury to sei whales was 0.8. This value includes incidental fishery interaction records, 0, and records of vessel collisions, 0.8 (Table 2; Henry *et al*. 2016). Annual rates calculated from detected mortalities should not be considered an unbiased estimate of human-caused mortality, but they represent a definitive lower bound. Detections are haphazard, incomplete, and not the result of a designed sampling scheme. As such they represent a minimum estimate of human-caused mortality which is almost certainly biased low.

### Fishery-Related Serious Injury and Mortality

No confirmed fishery-related mortalities or serious injuries of sei whales have been reported in the NMFS Sea Sampling bycatch database. A review of the records of stranded, floating, or injured sei whales for the period 2010 through 2014 on file at NMFS found no records with substantial evidence of fishery interactions causing serious injury or mortality (Table 2), which results in an annual serious injury and mortality rate of 0 sei whales from fishery interactions.

Table 2. Confirmed human-caused mortality and serious injury records of Sei Whales (*Balaenoptera borealis*) where the cause was assigned as either an entanglement (EN) or a vessel strike (VS): 2010–2014 [a]

| Date[b] | Injury Determination | ID | Location[b] | Assigned Cause | Value against PBR[c] | Country[d] | Gear Type[e] | Description |
|---|---|---|---|---|---|---|---|---|
| 3/26/2011 | Mortality | | Virginia Beach, VA | VS | 1 | US | - | Jaw, scapula, rib & vertebral fractures along right side w/ associated hemorrhaging. |
| 5/4/2014 | Mortality | | Hudson River, NY | VS | 1 | US | - | Fresh carcass on bow of vessel. Extensive skeletal fractures w/ associated hemorrhage along right side. |
| 5/7/2014 | Mortality | | Delaware River, PA | VS | 1 | US | - | Fresh carcass on bow of |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | vessel. |
| 8/14/2014 | Mortality | | James River, VA | VS | 1 | US | - | Live stranded and died. Emaciated. Fragment of plastic DVD case in stomach. Broken bones w/ associated hemorrhaging. Proximate COD – starvation by ingestion of plastic debris. Ultimate COD – blunt trauma from vessel strike |
| Five-year averages | | Shipstrike (US/CN/XU/XC) | | | 0.80 ( 0.80/ 0.00/ 0.00/ 0.00) | | | |
| | | Entanglement (US/CN/XU/XC) | | | 00 | | | |
| a. For more details on events please see Henry *et al.* 2016. | | | | | | | | |
| b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured. | | | | | | | | |
| c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012) | | | | | | | | |
| d. CN=Canada, US=United States, XC=Unassigned 1st sight in CN, XU=Unassigned 1st sight in US | | | | | | | | |
| e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir | | | | | | | | |

**Other Mortality**

For the period 2010 through 2014 files at NMFS included four records with substantial evidence of vessel collision causing serious injury or mortality (Table 2), which resulted in an annual rate of serious injury and mortality of 0.8 sei whales from vessel collisions.

**STATUS OF STOCK**

This is a strategic stock because the sei whale is listed as an endangered species under the ESA. The total U.S. fishery-related mortality and serious injury for this stock derived from the available records was less than 10% of the calculated PBR, and therefore could be considered insignificant and approaching a zero mortality and serious injury rate. However, evidence for fisheries interactions with large whales are subject to imperfect detection, and caution should be used in interpreting these results. The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for sei whales.

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# MINKE WHALE (*Balaenoptera acutorostrata acutorostrata*): Canadian East Coast Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Minke whales have a cosmopolitan distribution in temperate, tropical and high-latitude waters. In the North Atlantic, there are four recognized populations—Canadian East Coast, west Greenland, central North Atlantic, and northeastern North Atlantic (Donovan 1991). These divisions were defined by examining segregation by sex and length, catch distributions, sightings, marking data, and pre-existing ICES boundaries. However, there were very few data from the Canadian East Coast population. Anderwald *et al.* (2011) found no evidence for geographic structure comparing these putative populations but did, using individual genotypes and likelihood assignment methods, identify two cryptic stocks distributed across the North Atlantic. Until better information is available, minke whales off the eastern coast of the United States are considered to be part of the Canadian East Coast stock, which inhabits the area from the western half of the Davis Strait (45ºW) to the Gulf of Mexico. It is also uncertain if there are separate sub-stocks within the Canadian East Coast stock.

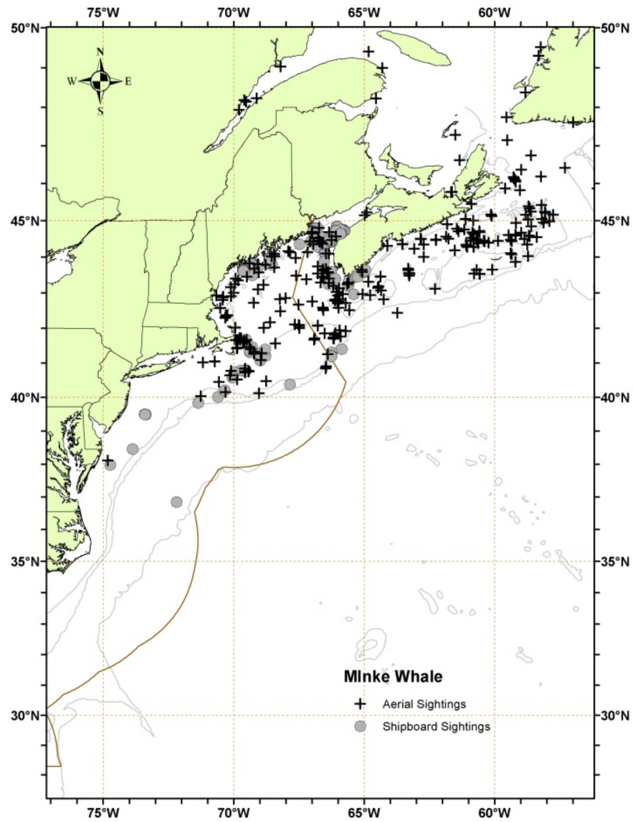


**Figure 1**. *Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011and DFO's 2007 TNASS survey. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

The minke whale is common and widely distributed within the U.S. Atlantic Exclusive Economic Zone (EEZ) (CETAP 1982). There appears to be a strong seasonal component to minke whale distribution on both the continental shelf and in deeper, off-shelf waters. Spring to fall are times of relatively widespread and common occurrence on the shelf, and when the whales are most abundant in New England waters (e.g., Risch *et al.* 2013; 2014), while during the fall to spring period the species appears to be relatively widespread and common on deep-ocean waters (Clark and Gagnon 2002) . Records based on visual sightings and summarized by Mitchell (1991) hinted at a possible winter distribution in the West Indies, and in the mid-ocean south and east of Bermuda. In contrast, acoustic monitoring for minke whales have revealed minke acoustic occurrence throughout broad, deep-ocean areas of the western North Atlantic from late October through early June (Clark and Gagnon 2002).

## POPULATION SIZE

The best recent abundance estimate for this stock is 2,591 (CV=0.81) minke whales. This estimate, derived from 2011 shipboard and aerial surveys, is the only current estimate available. This estimate is substantially lower than the estimate from the previous (2015) SAR. This is because the previous estimate included data from the 2007 TNASS surveys of Canadian waters. For the purposes of this SAR, as recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, so this new estimate must not include data from the 2007 TNASS survey. This new estimate should not be interpreted as a decline in abundance of this stock, as previous estimates are not directly comparable.

**Earlier estimates**

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for the determination of the current PBR.

**Recent surveys and abundance estimates**

An abundance estimate of 2,591 (CV=0.81) minke whales was generated from a shipboard and aerial survey conducted during June-August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of central Virginia to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a double-platform data collection procedure, which allows estimation of abundance corrected for perception bias of the visually detected species (Laake and Borchers, 2004). Estimation of the abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the multiple-covariate distance sampling (MCDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Table 1. Summary of recent abundance estimates for the Canadian East Coast stock of minke whales (*Balaenoptera acutorostrata acutorostrata*) by 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 |
|---|---|---|---|
| Jul-Aug 2011 | Central Virginia to lower Bay of Fundy | 2,591 | 0.81 |

**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 Canadian East Coast stock of minke whales is 2,591animals (CV=0.81). The minimum population estimate is 1,425 animals.

**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**

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity are that females mature between 6 and 8 years of age, and pregnancy rates are approximately 0.86 to 0.93. Based on these parameters, the calving interval is between 1 and 2 years. Calves are probably born during October to March after 10 to 11 months gestation and nursing lasts for less than 6 months. Maximum ages are not known, but for Southern Hemisphere minke whales maximum age appears to be about 50 years (IWC 1991; Katona *et al.* 1993).

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 is 1,425. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5, the default value for stocks of unknown status relative to OSP, and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the Canadian east coast minke whale is 14.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

During 2010 to 2014, the average annual minimum detected human-caused mortality and serious injury was 8.25 minke whales per year: 0.2 minke whales per year from observed U.S. fisheries, 6.45 (1.7 U.S/2.5 Canada/2.25 unassigned but first reported in the U.S.) minke whales per year from U.S. and Canadian fisheries using strandings and entanglement data, and 1.6 (1.2 U.S./0.4 Canada) per year from vessel strikes.

Data to estimate the mortality and serious injury of minke whales come from the Northeast Fisheries Science Center Observer Program, the At-Sea Monitor Program, and from records of strandings and entanglements in U.S. and Canadian waters. For the purposes of this report, mortalities and serious injuries from reports of strandings and entanglements considered confirmed human-caused mortalities or serious injuries are shown in Table 2 while those recorded by the Observer or At-Sea Monitor Programs are shown in Table 3.

Detected interactions in the strandings and entanglement data should not be considered an unbiased representation of human-caused mortality. Detections are haphazard and not the result of a designed sampling scheme. As such they represent a minimum estimate, which is almost certainly biased low.

### Fishery Information

Detailed fishery information is reported in Appendix III.

### Earlier Interactions

For more details on the historical fishery interactions prior to 1999, see Waring *et al.* (2007).

In 2002, one minke whale mortality and one live release were attributed to the lobster trap fishery. A June 2003 mortality, while wrapped in lobster gear, cannot be confirmed to have become entangled in the area, and so is not attributed to the fishery. Annual mortalities due to the northeast/mid-Atlantic Lobster Trap/Pot fishery, as determined from strandings and entanglement records that have been audited, were 1 in 1991, 2 in 1992, 1 in 1994, 1 in 1995, 0 in 1996, 1 in 1997, 0 in 1998 to 2001, 1 in 2002, and 0 in 2003 through 2011. See Appendix V for more information on historical takes.

### U.S.

### Northeast Mid-water Trawl Fishery (Including Pair Trawl)

During July 2013, one minke whale was observed dead in the mid-water otter trawl on Georges Bank. Due to the small sample size of observed takes, an expanded estimate was not calculated. Annual average estimated minke whale mortality and serious injury from the mid-Atlantic mid-water trawl (including pair trawl) during 2010 to 2014 was 0.2 (Table 3).

### Atlantic Large Pelagics Longline Fishery

In 2010, a minke whale was caught but released alive (no serious injury) in the large pelagics longline fishery, South Atlantic Bight fishing area (Garrison and Stokes 2012).

### Other Fisheries

The audited NE Regional Office/NMFS entanglement/stranding database contains records of minke whales, of which the confirmed mortalities and serious injuries from the last five years are reported in Table 2. During 2010 to 2014, as determined from stranding and entanglement records confirmed to be of U.S. origin or first sighted in U.S. waters, the minimum detected average annual mortality and serious injury was 3.95 minke whales per year in U.S. fisheries (Table 2a). Most cases where gear was recovered and identified involved gillnet or pot/trap gear.

### CANADA

Read (1994) reported interactions between minke whales and gillnets in Newfoundland and Labrador, in cod traps in Newfoundland, and in herring weirs in the Bay of Fundy. Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on between 25% and 40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. During 1991 through 1996, no minke whales were observed taken.

### Herring Weirs

During 1980 to 1990, 15 of 17 minke whales were released alive from herring weirs in the Bay of Fundy. During January 1991 to September 2002, 26 minke whales were trapped in herring weirs in the Bay of Fundy. Of these 26, 1 died (H. Koopman, pers. comm.) and several (number unknown) were released alive and unharmed (A. Westgate, pers. comm.). Weir interactions that may have resulted in serious injury to minke whales are reported in Table 2b.

**Other Fisheries**

Mortalities and serious injuries that were likely a result of an interaction with an unknown Canadian fishery are detailed in Table 2b. During 2010 to 2014, as determined from stranding and entanglement records confirmed to be of Canadian origin or first sighted in Canadian waters, the minimum detected average annual mortality and serious injury was 2.5 minke whales per year in Canadian fisheries (Table 2b; prorated value).

Table 2a. Confirmed human-caused mortality and serious injury records of minke whales (*Balaenoptera acutorostrata acutorostrata*) first reported in U.S. waters or attributed to U.S.: 2010–2014[a]

| Date[b] | Injury determination | ID | Location[b] | Assigned Cause[f] | Value against PBR[c] | Country[d] | Gear Type[e] | Description |
|---|---|---|---|---|---|---|---|---|
| 7/9/2010 | Mortality | - | Fire Island Inlet, NY | VS | 1 | US | - | 3-4 large dorsal lacerations associated w/ fractured ribs |
| 8/21/2010 | Serious Injury | - | off Plymouth Harbor, MA | EN | 1 | XU | NR | Embedded rostrum wrap. |
| 5/6/2011 | Mortality | - | off Martha's Vineyard, MA | EN | 1 | US | PT | Anchored in gear. Embedded line at fluke. Evidence of entanglement w/ associated hemorrhaging at mouth corners & insertion of pectorals |
| 7/17/2011 | Prorated Injury | - | off Nahant, MA | EN | 0.75 | XU | NR | Full configuration unknown. |
| 7/24/2011 | Prorated Injury | - | off North Truro, MA | EN | 0.75 | XU | NR | Full configuration unknown |
| 8/4/2011 | Mortality | - | Sandy Hook Bay, NJ | VS | 1 | US | - | 4 propeller lacerations across dorsal surface. Fractured ribs w/associated hemorrhaging |
| 8/26/2011 | Mortality | - | Horseshoe Cove, NJ | EN | 1 | US | NP | Fresh carcass w/ evidence of extensive entanglement |
| 8/29/2011 | Mortality | - | Moriches Bay, NY | VS | 1 | US | - | Extensive hemorrhage & edema along dorsal & both lateral surfaces |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10/6/2011 | Mortality | - | off Matinicus Island, ME | EN | 1 | US | PT | Fresh carcass anchored in gear |
| 12/7/2011 | Mortality | - | Carolina Beach, NC | VS | 1 | US | - | Healed deep & superficial propeller lacerations; internal lesions associated w/ deep lacerations indicative of peritonitis & infection |
| 2/4/2012 | Prorated Injury | - | off Virginia Beach, VA | EN | 0.75 | XU | CE | Reported with hook/monofilament gear. Attachment point unknown. |
| 3/16/2012 | Mortality | - | Ipswich, MA | EN | 1 | US | NP | Evidence of extensive, constricting gear w/ associated hemorrhaging |
| 6/21/2012 | Serious Injury | - | off Frenchboro, ME | EN | 1 | XU | NR | Constricting body wrap, flipper pinned, embedded in mouthline; emaciated |
| 6/23/2012 | Mortality | - | Newark, NJ | VS | 1 | US | - | Fresh carcass on bow of ship. Deep laceration across ventral surface; Cause of death - disembowlment & hypovolemic shock |
| 7/1/2012 | Prorated Injury | - | off Portsmouth, NH | EN | 0.75 | XU | NR | Full configuration unknown |
| 7/13/2012 | Prorated Injury | - | off Jonesport, ME | EN | 0.75 | US | NR | Anchored. Partial disentanglement; Final configuration unknown |
| 7/17/2012 | Serious Injury | - | off Chatham, MA | EN | 1 | XU | NR | Tight wrap across back; health decline: emaciated |
| 8/2/2012 | Prorated Injury | - | off Provincetown, MA | EN | 0.75 | XU | NR | Full configuration unknown |
| 8/5/2012 | Mortality | - | Chatham, MA | EN | 1 | US | NR | Multiple constricting wraps through & around mouth and on fluke blades; COD - acute underwater entrapment |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10/4/2012 | Mortality | - | Cliff Island, ME | EN | 1 | US | NR | Evidence of constricting gear at mouthline, across ventral pleats, & at peduncle |
| 7/23/2013 | Prorated Injury | - | off Newport, RI | EN | 0.75 | XU | NR | Full configuration unknown |
| 8/17/2013 | Serious Injury | - | off Newburyport, MA | EN | 1 | XU | NR | Constricting rostrum wrap cutting into upper lip |
| 10/04/2013 | Prorated Injury | - | off Seal Harbor, ME | EN | 0.75 | US | NR | Anchored, partially disentangled, final configuration unknown |
| 6/9/2014 | Mortality | - | off Truro, MA | EN | 1 | US | PT | Fresh carcass anchored, hog-tied in gear. COD=peracute underwater entrapment. |
| 7/10/2014 | Prorated Injury | - | S of Bristol, ME | EN | 0.75 | XU | NR | Free-swimming, trailing 2 buoys. Attachment point(s) unknown. |
| 7/12/2014 | Serious Injury | - | South Shinnecock Inlet, NY | EN | 1 | XU | NR | Free-swimming with yellow plastic strapping cutting into top and sides of rostrum. No trailing gear. |
| 7/17/2014 | Mortality | - | South Addison, ME | EN | 1 | XU | NP | Fresh carcass with line impression across ventral surface & evidence of constricting gear around peduncle and fluke insertion. Bruising evident at fluke injuries. No gear present. |
| 12/24/2014 | Mortality | - | Dam Neck, VA | VS | 1 | US | - | Fresh carcass with broken ribs & fractured vertebrae w/ extensive hemorrhage & edema. |
| Five-year averages | | Vessel strike (US/ XU) | | 1.20 ( 1.20/ 0.00) | | | | |
| | | Entanglement (US/ XU) | | 3.95 ( 1.70/ 2.25) | | | | |
| a. For more details on events please see Henry *et al.* 2016. | | | | | | | | |
| b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured. | | | | | | | | |

| |
|---|
| c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012) |
| d. US=United States, XU=Unassigned 1st sight in US |
| e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, MT=midwater trawl, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir |
| f. Assigned cause: EN=entanglement, VS=vessel strike, ET=entrapment (summed with entanglement). |

Table 2b. Confirmed human-caused mortality and serious injury records of minke whales (*Balaenoptera acutorostrata acutorostrata*) first reported in Canadian waters or attributed to Canada: 2010–2014[a]

| Date[b] | Injury determination | ID | Location[b] | Assigned Cause[f] | Value against PBR[c] | Country[d] | Gear Type[e] | Description |
|---|---|---|---|---|---|---|---|---|
| 6/16/2010 | Mortality | - | Goose River, Prince Edward Island | EN | 1 | CN | NP | Deep laceration consistent w/ entanglement at base of fluke w/ associated hemorrhage |
| 7/2/2010 | Mortality | - | Naufrage, Prince Edward Island | EN | 1 | CN | NP | Evidence of body entanglement & constriction at mouthline |
| 7/27/2010 | Prorated Injury | - | off Bliss Island, New Brunswick | ET | 0.75 | CN | WE | Live in weir. Not present next day. Unclear if whale swam out or drowned. |
| 6/3/2011 | Serious Injury | - | Tadoussac, Quebec | EN | 1 | CN | NR | Tight rostrum wrap. |
| 9/7/2011 | Prorated Injury | - | Greenspond, Newfoundland | EN | 0.75 | CN | GN | Partially disentangled from anchoring gear. Final configuration unknown. |
| 9/19/2011 | Prorated Injury | - | Northumberland Strait, Prince Edward Island | EN | 0.75 | CN | NR | Partially disentangled from anchoring gear. Final configuration unknown. |
| 12/19/2011 | Mortality | - | off Grand Manan Island, New Brunswick | EN | 1 | CN | PT | Live entanglement; recovered dead in gear the following day. Constricting peduncle wraps |
| 5/15/2012 | Serious Injury | - | Sable Island Bank, Canada | EN | 1 | CN | PT | Disentangled from gear embedded down to bone of |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | peduncle. |
| 6/26/2012 | Mortality | - | Renews Rock, Newfoundland | EN | 1 | CN | PT | Fresh carcass w/ constricting gear around peduncle |
| 6/30/2012 | Mortality | - | off Naufrage, Prince Edward Island | EN | 1 | CN | PT | Fresh carcass anchored in gear |
| 7/1/2012 | Mortality | - | Northern Lake Harbor, Prince Edward Island | EN | 1 | CN | PT | Constricting gear w/ associated hemorrhaging; COD - drowning |
| 8/31/2013 | Mortality | - | Miminegash, Prince Edward Island | EN | 1 | CN | NP | Fresh carcass w/ evidence of extensive, constricting gear |
| 7/2/2014 | Mortality | - | Northumberland Strait, NB | EN | 1 | CN | NR | Carcass with constricting gear around lower jaw. Large open injury at attachment point on the left side. |
| 7/10/2014 | Mortality | - | Cape George, Antigonish, NS | VS | 1 | CN | - | Fresh carcass with jaw fractures. |
| 7/29/2014 | Mortality | - | 5 nm E of Herring Cove, NS | VS | 1 | CN | - | Live animal w/ tongue completely ballooned out, forcing its jaws 90 degrees apart. Found dead at same location the next day. Carcass recovered with two traps & constricting line around the peduncle. Necropsy found indication of blunt trauma to right jaw. Animal anchored in gear was subsequently struck by a vessel (primary cause of death) |
| Five-year averages | | Vessel strike (CN/ XC) | | | 0.40 (0.40/ 0.00) | | | |
| | | Entanglement (CN/ XC) | | | 2.50 (2.50/ 0.00) | | | |
| a. For more details on events please see Henry *et al.* 2016. | | | | | | | | |

| |
|---|
| b. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured. |
| c. Mortality events are counted as 1 against PBR. Serious injury events have been evaluated using NMFS guidelines (NOAA 2012) |
| d. CN=Canada, US=United States, XC=Unassigned 1st sight in CN, XU=Unassigned 1st sight in US |
| e. H=hook, GN=gillnet, GU=gear unidentifiable, MF=monofilament, MT=midwater trawl, NP=none present, NR=none recovered/received, PT=pot/trap, WE=weir |
| f. Assigned cause: EN=entanglement, VS=vessel strike, ET=entrapment (summed with entanglement). |

Table 3. Summary of the incidental mortality and serious injury of Canadian East Coast stock of minke whales (*Balaenoptera acutorostrata acutorostrata*) by commercial fishery including the years sampled, the type of data used, the annual observer coverage, the serious injuries and mortalities recorded by on-board observers, the estimated annual serious injury and mortality, the estimated CV of the combined annual mortality and the mean annual mortality (CV in parentheses).

| Fishery | Years | Data Type[a] | Observer Coverage[b] | Observed Serious Injury | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Estimated CVs | Mean Combined Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Mid-water Trawl - Including Pair Trawl | 10-14 | Obs. Data Weighout Trip Logbook | .41, .17, .45, .37, | 0, 0, 0, 0, 0 | 0, 0, 0, 1, 0 | 0, 0, 0, 0, 0 | 0, 0, 0, 1, 0 | 0, 0, 0, 1, 0 | 0, 0, 0, 0, 0 | 0.2 (0) |
| TOTAL | | | | | | | | | | 0.2 (0) |

[a] Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Fisheries Observer Program and mandatory Vessel Trip Reports (VTR) (Trip Logbook) are used to determine the spatial distribution of landings and fishing effort.

[b] Northeast mid-water trawl (including pair trawl) fisheries coverage is ratios based on trips.

**Other Mortality**

North Atlantic minke whales have been and continue to be hunted. From the Canadian East Coast population, documented whaling occurred from 1948 to 1972 with a total kill of 1,103 animals (IWC 1992). Animals from other North Atlantic minke populations (e.g. Iceland) are being harvested presently.

**U.S.**

Minke whales inhabit coastal waters during much of the year and are thus susceptible to collision with vessels. In 2010 a juvenile male minke was discovered killed by vessel strike off Fire Island, New York. In 2011, three juvenile minkes were confirmed dead due to vessel strikes: a female off Sandy Hook, New Jersey, a female off Moriches, New York, and a male off Carolina Beach, North Carolina. In 2012, a confirmed vessel strike resulted in a mortality off Newark, New Jersey. In 2014, a confirmed vessel strike resulted in a mortality off Dam Neck, Virginia. Thus, during 2010–2014, as determined from stranding and entanglement records, the minimum detected annual average was 1.2 minke whales per year struck by vessels in U.S. waters or first seen in U.S. waters (Table 2a;

Henry *et al.* 2016).

## CANADA

The Nova Scotia Stranding Network documented whales and dolphins stranded on the coast of Nova Scotia between 1991 and 1996 (Hooker *et al.* 1997). Researchers with the Department of Fisheries and Oceans, Canada documented strandings on the beaches of Sable Island (Lucas and Hooker 2000). Starting in 1997, minke whales stranded on the coast of Nova Scotia were recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network. The events that are determined to be human-caused serious injury or mortality are included in Table 2b.

The Whale Release and Strandings program has reported the following minke whale stranding mortalities in Newfoundland and Labrador for the time period of this report: 1 in 2010, 0 in 2011, 3 in 2012, and 0 in 2013 and 1 in 2014. Those that have been determined to be human-caused serious injury or mortality are included in Table 2b (Ledwell and Huntington 2011, 2012, 2012b, 2013, 2014).

During 2010–2014, as determined from stranding and entanglement records, the minimum detected annual average was 0.4 minke whales per year struck by vessels in Canadian waters or first seen in Canadian waters (Table 2b; Henry *et al.* 2016).

## STATUS OF STOCK

Minke whales are not listed as threatened or endangered under the Endangered Species Act, and the Canadian East Coast stock is not considered strategic under the Marine Mammal Protection Act. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of minke whales relative to OSP in the U.S. Atlantic EEZ is unknown.

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# DWARF SPERM WHALE (*Kogia sima*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale (*Kogia sima*) is distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989; McAlpine 2009). Sightings of *Kogia* whales in the western North Atlantic occur in oceanic waters (Figure 1; Mullin and Fulling 2003; Roberts *et al.* 2015). Stranding records exist from Florida to Maine, but there are no stranding records for the eastern Canadian coast (Willis and Baird 1998).

Dwarf sperm whales and pygmy sperm whales (*K. breviceps*) are difficult to differentiate at sea due to similarities in appearance (Caldwell and Caldwell 1989; Bloodworth and Odell 2008; McAlpine 2009), and sightings of either species are often categorized as *Kogia* sp. When measurements can be obtained, diagnostic morphological characters have been useful in distinguishing the two *Kogia* species (Handley 1966; Barros and Duffield 2003), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin in proportion to the animal's total length, can be used to differentiate between the two *Kogia* species (Handley 1966; Barros and Duffield 2003).

In addition to similarities in appearance, dwarf sperm whales and pygmy sperm whales demonstrate similarities in their foraging ecology. Staudinger *et al.* (2014) conducted diet and stable isotope analyses on stranded pygmy and dwarf sperm whales from the mid-Atlantic coast and found that the 2 species shared the same primary prey and fed in similar habitats.

Across its geographic range, including the western North Atlantic, the population biology of dwarf sperm whales is inadequately known (Staudinger *et al.* 2014). The western North Atlantic dwarf sperm whale population is being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

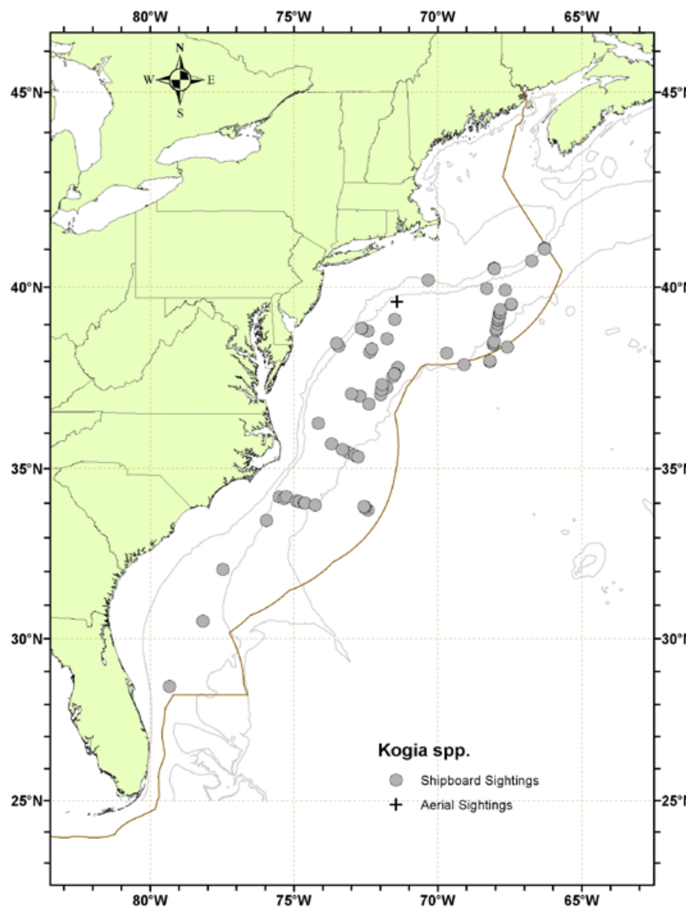


**Figure 1.** *Distribution of* Kogia *spp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers in 2004 and 2011. Isobaths are the 100-m, 1,000-m and 4,000- m depth contours.*

## POPULATION SIZE

Total numbers of dwarf sperm whales off the U.S. Atlantic coast are unknown, although abundance estimates from selected regions of dwarf sperm whale habitat exist for select time periods. Because *K. sima* and *K. breviceps* are difficult to differentiate at sea, the reported abundance estimates are for both species of *Kogia* combined. The best estimate for *Kogia* spp. in the western North Atlantic is 3,785 (CV=0.47; Table 1; Palka 2012; Garrison 2016). This estimate is from summer 2011 surveys covering waters from central Florida to the lower Bay of Fundy. This estimate is almost certainly negatively biased. One component of line transect estimates is *g(0)*, the probability of seeing an animal on the transect line. Estimating *g(0)* is difficult because it consists of accounting for both perception bias (i.e., at the surface but missed) and availability bias (i.e., below the surface while in range of the observers), and many uncertainties (e.g., group size and diving behavior) can confound both (Marsh and Sinclair 1989; Barlow 1999). The best estimate was corrected for perception bias (see below) but not availability bias and is therefore an underestimate.

**Earlier abundance estimates**

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

**Recent surveys and abundance estimates**

An abundance estimate of 1,783 (CV=0.62) *Kogia* spp. was generated from aerial and shipboard surveys conducted during June–August 2011 between central Virginia and the lower Bay of Fundy (Palka 2012). The aerial portion covered 6,850 km of tracklines over waters north of New Jersey between the coastline and the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. The shipboard portion covered 3,811 km of trackline between central Virginia and Massachusetts in waters deeper than the 100-m depth contour out to beyond the U.S. EEZ. Both sighting platforms used a double-platform data collection procedure, which allowed estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

An abundance estimate of 2,002 (CV=0.69) *Kogia* spp. was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida (Garrison 2016). This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed two independent visual teams searching with 25x bigeye binoculars. A total of 4,445 km of trackline were surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break with generally lower sighting rates over the continental slope. Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Table 1. Summary of abundance estimates for the western North Atlantic *Kogia* spp. with 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 2011 | central Virginia to lower Bay of Fundy | 1,783 | 0.62 |
| Jun–Aug 2011 | central Florida to central Virginia | 2,002 | 0.69 |
| Jun–Aug 2011 | central Florida to lower Bay of Fundy (COMBINED) | 3,785 | 0.47 |

**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 *Kogia* spp. is 3,785 (CV=0.47). The minimum population estimate for *Kogia* spp. is 2,598 animals.

**Current Population Trend**

A trend analysis has not been conducted for this stock. There are 3 abundance estimates for *Kogia* spp. from: 1) summer 1998 surveys (536; CV=0.45); 2) summer 2004 surveys (395; CV=0.4); and 3) summer 2011 surveys (3,785; CV=0.47). Methodological differences between the estimates need to be evaluated to quantify trends.

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations 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 *Kogia* spp. is 2,598. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.40 because the CV of the average mortality estimate is greater than 0.8 (Wade and Angliss 1997). PBR for western North Atlantic *Kogia* spp. is 21.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated annual average fishery-related mortality or serious injury for *Kogia* sp. during 2010–2014 was 3.5 (CV=1.0; Table 2).

### Fishery Information

The commercial fisheries that interact, or that could potentially interact, with this stock in the Atlantic Ocean are the Category I Atlantic Highly Migratory Species longline and Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fisheries (Appendix III).

The large pelagics longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ. Pelagic swordfish, tunas and billfish are the targets of the large pelagics longline fishery. Total estimated annual average fishery-related mortality and serious injury during 2010–2014 was unknown for Atlantic dwarf sperm whales because species-specific mortality estimates could not be made. However, there was 1 report of a *Kogia* sp. seriously injured by the pelagic longline fishery during quarter 4 of 2011 in the mid-Atlantic Bight region. Estimated total serious injury of *Kogia* sp. attributable to the pelagic longline fishery during 2011 was 17.4 (CV=1.0; Garrison and Stokes 2012b). The annual average serious injury and mortality attributable to the Atlantic large pelagics longline fishery for the 5-year period from 2010 to 2014 was 3.5 animals (CV=1.0; Table 2) (Garrison and Stokes 2012a,b; 2013; 2014; 2016).

The Atlantic Highly Migratory Species longline fishery operates outside the U.S. EEZ. No takes of dwarf sperm whales or *Kogia* sp. within high seas waters of the Atlantic Ocean have been observed or reported thus far.

See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and AppendixV for historical estimates of annual mortality and serious injury.

Table 2. Summary of the incidental mortality and serious injury of Atlantic Ocean *Kogia* sp. in the pelagic longline commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the annual observed serious injury and mortality recorded by on-board observers, the annual estimated serious injury and mortality, the combined annual estimates of serious injury and mortality (Estimated Combined Mortality), the estimated CV of the combined annual mortality estimates (Est. CVs) and the mean of the combined mortality estimates (CV in parentheses).

| Fishery | Years | Vessels [a] | Data Type [b] | Observer Coverage [c] | Observed Serious Injury | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Est. CVs | Mean Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pelagic Longline | 2010 – 2014 | 80, 83, 82, 79, 78 | Obs. Data Logbook | .08, .09, .07, .09, .10 | 0,1,0,0,0 | 0,0,0,0,0 | 0,17,0,0,0 | 0,0,0,0,0 | 0,17,0,0,0 | NA, 1.00, NA, NA, NA | 3.5 (1.0) |
| TOTAL | | | | | | | | | | | 3.5 (1.0) |

[a] Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.
[b] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).
[c] Proportion of sets observed.

### Earlier Interactions

Between 1992 and 2009, 1 *Kogia* sp. was hooked, released alive and considered seriously injured in 2000 (in the Florida East coast fishing area) (Yeung 2001).

### Other Mortality

During 2010–2014, 34 dwarf sperm whales were reported stranded along the U.S. Atlantic coast and Puerto Rico (Table 3; Northeast Regional Marine Mammal Stranding Network, Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015 (SER) and 9 June 2015 (NER)). In addition, there were 11 records of unidentified stranded *Kogia*.

Table 3. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (Kb) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2010–2014. Strandings that were not reported to species have been reported as *Kogia* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded *Kogia* whales to species, reports to specific species should be viewed with caution.

| STATE | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | | TOTALS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp |
| Maine | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Massachusetts | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| New York | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 7 | 0 |
| New Jersey | 0 | 3 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 7 | 0 |
| Delaware | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 |
| Maryland | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 0 |
| Virginia | 0 | 2 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 4 | 7 | 0 |
| North Carolina | 3 | 5 | 0 | 2 | 10 | 0 | 0 | 4 | 0 | 3 | 3 | 1 | 3 | 4 | 1 | 11 | 26 | 2 |
| South Carolina | 1 | 6 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 3 | 0 | 5 | 13 | 0 |
| Georgia | 0 | 2 | 1 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 5 | 1 | 5 | 1 | 0 | 5 | 16 | 2 |
| Florida | 3 | 17 | 0 | 2 | 14 | 1 | 0 | 10 | 0 | 0 | 9 | 6 | 0 | 9 | 0 | 5 | 59 | 7 |
| Puerto Rico | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| TOTALS | 8 | 38 | 1 | 8 | 34 | 1 | 2 | 21 | 0 | 7 | 26 | 8 | 9 | 23 | 1 | 34 | 142 | 11 |

There were two documented strandings of dwarf sperm whales along the U.S. Atlantic coast during 2010–2014 with evidence of human interactions. The first was a whale stranded in Florida during 2010 whose flukes were cut off by a public person on the beach. For the second, plastic was found in the stomach of an animal that stranded in New Jersey during 2011.

Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al*. 2012; Wells *et al*. 2015). Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al*. 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

## STATUS OF STOCK

Dwarf sperm whales are not listed as threatened or endangered under the Endangered Species Act, and the western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. Total U.S. fishery-related mortality and serious injury for *Kogia* sp. is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of dwarf sperm whales in the U.S. Atlantic EEZ relative to OSP is unknown. There are insufficient data to determine population trends for this species.

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# PYGMY SPERM WHALE (*Kogia breviceps*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy sperm whale (*Kogia breviceps*) is distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989; McAlpine 2009). Sightings of *Kogia* whales in the western North Atlantic occur in oceanic waters (Figure 1; Mullin and Fulling 2003; Roberts *et al.* 2015). Stranding records exist from Florida to Maine, but there are no stranding records for the east Canadian coast (Willis and Baird 1998).

Pygmy sperm whales and dwarf sperm whales (*K. sima*) are difficult to differentiate at sea (Caldwell and Caldwell 1989; Bloodworth and Odell 2008; McAlpine 2009), and sightings of either species are often categorized as *Kogia* sp. When measurements can be obtained, diagnostic morphological characters have been useful in distinguishing the two *Kogia* species (Handley 1966; Barros and Duffield 2003), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin in proportion to the animal's total length, can be used to differentiate between the two *Kogia* species (Handley 1966; Barros and Duffield 2003).

In addition to similarities in appearance, dwarf sperm whales and pygmy sperm whales demonstrate similarities in their foraging ecology. Staudinger *et al.* (2014) conducted diet and stable isotope analyses on stranded pygmy and dwarf sperm whales from the mid-Atlantic coast and found that the two species shared the same primary prey and fed in similar habitats.

Across its geographic range, including the western North Atlantic, the population biology of dwarf sperm whales is inadequately known (Staudinger *et al.* 2014). The western North Atlantic pygmy sperm whale population is being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

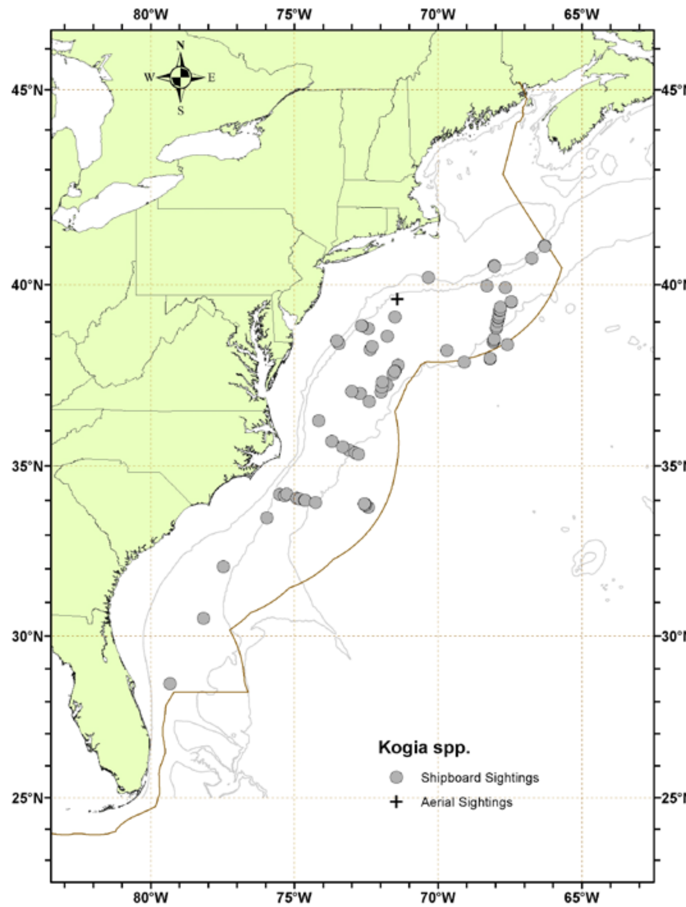


**Figure 1.** *Distribution of* Kogia *spp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers in 2004 and 2011. Isobaths are the 100-m, 1,000-m and 4,000-m depth contours.*

## POPULATION SIZE

Total numbers of pygmy sperm whales off the U.S. Atlantic coast are unknown, although abundance estimates from selected regions of pygmy sperm whale habitat do exist for select time periods. Because *K. breviceps* and *K. sima* are difficult to differentiate at sea, the reported abundance estimates are for both species of *Kogia* combined. The best abundance estimate for *Kogia* spp. in the western North Atlantic is 3,785 (CV=0.47; Table 1; Palka 2012; Garrison 2016). This estimate is from summer 2011 surveys covering waters from central Florida to the lower Bay of Fundy. This estimate is almost certainly negatively biased. One component of line transect estimates is *g(0)*, the probability of seeing an animal on the transect line. Estimating *g(0)* is difficult because it consists of accounting for both perception bias (i.e., at the surface but missed) and availability bias (i.e., below the surface while in range of the observers), and many uncertainties (e.g., group size and diving behavior) can confound both (Marsh and Sinclair 1989; Barlow 1999). The best estimate was corrected for perception bias (see below) but not availability bias and is therefore an underestimate.

**Earlier abundance estimates**

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

**Recent surveys and abundance estimates**

An abundance estimate of 1,783 (CV=0.62) *Kogia* spp. was generated from aerial and shipboard surveys conducted during June–August 2011 between central Virginia and the lower Bay of Fundy (Palka 2012). The aerial portion covered 6,850 km of trackline over waters north of New Jersey between the coastline and the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. The shipboard portion covered 3,811 km of trackline between central Virginia and Massachusetts in waters deeper than the 100-m depth contour out to beyond the U.S. EEZ. Both sighting platforms used a double-platform data collection procedure, which allowed estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

An abundance estimate of 2,002 (CV=0.69) *Kogia* spp. was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida (Garrison 2016). This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed two independent visual teams searching with 25x bigeye binoculars. A total of 4,445 km of trackline were surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break with generally lower sighting rates over the continental slope. Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Table 1. Summary of abundance estimates for the western North Atlantic *Kogia* spp. with 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 2011 | central Virginia to lower Bay of Fundy | 1,783 | 0.62 |
| Jun–Aug 2011 | central Florida to central Virginia | 2,002 | 0.69 |
| Jun–Aug 2011 | central Florida to lower Bay of Fundy (COMBINED) | 3,785 | 0.47 |

**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 *Kogia* spp. is 3,785 (CV=0.47). The minimum population estimate for *Kogia* spp. is 2,598 animals.

**Current Population Trend**

A trend analysis has not been conducted for this stock. There are 3 abundance estimates for *Kogia* spp. from: 1) summer 1998 surveys (536; CV=0.45); 2) summer 2004 surveys (395; CV=0.4); and 3) summer 2011 surveys (3,785; CV=0.47). Methodological differences between the estimates need to be evaluated to quantify trends.

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations 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 *Kogia* spp. is 2,598. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.40 because the CV of the average mortality estimate is greater than 0.8 (Wade and Angliss 1997). PBR for western North Atlantic *Kogia* spp. is 21.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated annual average fishery-related mortality or serious injury for *Kogia* sp. during 2010–2014 was 3.5 (CV=1.0; Table 2).

### Fishery Information

The commercial fisheries that interact, or that could potentially interact, with this stock in the Atlantic Ocean are the Category I Atlantic Highly Migratory Species longline and Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fisheries (Appendix III).

The large pelagics longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ. Pelagic swordfish, tunas and billfish are the targets of the large pelagics longline fishery. Total estimated annual average fishery-related mortality and serious injury during 2010–2014 was unknown for Atlantic pygmy sperm whales because species-specific mortality estimates could not be made. However, there was 1 report of a *Kogia* sp. seriously injured by the pelagic longline fishery during quarter 4 of 2011 in the mid-Atlantic Bight region. Estimated total serious injury of *Kogia* attributable to the pelagic longline fishery during 2011 was 17.4 (CV=1.0; Garrison and Stokes 2012b). The annual average serious injury and mortality for *Kogia* sp. attributable to the Atlantic large pelagics longline fishery for the 5-year period from 2010 to 2014 was 3.5 animals (CV=1.0; Table 2) (Garrison and Stokes 2012a,b; 2013; 2014; 2016).

The Atlantic Highly Migratory Species longline fishery operates outside the U.S. EEZ. No takes of pygmy sperm whales or *Kogia* sp. within high seas waters of the Atlantic Ocean have been observed or reported thus far.

See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical estimates of annual mortality and serious injury.

Table 2. Summary of the incidental mortality and serious injury of Atlantic Ocean *Kogia* sp. in the pelagic longline commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the annual observed serious injury and mortality recorded by on-board observers, the annual estimated serious injury and mortality, the combined annual estimates of serious injury and mortality (Estimated Combined Mortality), the estimated CV of the combined annual mortality estimates (Est. CVs) and the mean of the combined mortality estimates (CV in parentheses).

| Fishery | Years | Vessels [a] | Data Type [b] | Observer Coverage [c] | Observed Serious Injury | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Est. CVs | Mean Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pelagic Longline | 2010–2014 | 80, 83, 82, 79, 78 | Obs. Data Logbook | .08, .09, .07, .09, .10 | 0,1,0,0,0 | 0,0,0,0,0 | 0,17,0,0,0 | 0,0,0,0,0 | 0,17,0,0,0 | NA, 1.00, NA, NA, NA | 3.5 (1.0) |
| TOTAL | | | | | | | | | | | 3.5 (1.0) |

[a] Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.
[b] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).
[c] Proportion of sets observed.

### Earlier Interactions

Between 1992 and 2009, 1 *Kogia* sp. was hooked, released alive and considered seriously injured in the pelagic longline fishery in the Atlantic in 2000 (Yeung 2001).

**Other Mortality**

During 2010–2014, 142 pygmy sperm whales were reported stranded along the U.S. Atlantic coast and Puerto Rico (Table 3; Northeast Regional Marine Mammal Stranding Network, Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015 (SER) and 9 June 2015 (NER)). In addition, there were 11 records of unidentified *Kogia*.

Table 3. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (Kb) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2010–2014. Strandings that were not reported to species have been reported as *Kogia* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded *Kogia* whales to species, reports to specific species should be viewed with caution.

| STATE | 2010 | | | 2011 | | | 2012 | | | 2013 | | | 2014 | | | TOTALS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp | Ks | Kb | Sp |
| Maine | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Massachusetts | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| New York | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 7 | 0 |
| New Jersey | 0 | 3 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 7 | 0 |
| Delaware | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 |
| Maryland | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 0 |
| Virginia | 0 | 2 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 4 | 7 | 0 |
| North Carolina | 3 | 5 | 0 | 2 | 10 | 0 | 0 | 4 | 0 | 3 | 3 | 1 | 3 | 4 | 1 | 11 | 26 | 2 |
| South Carolina | 1 | 6 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 3 | 0 | 5 | 13 | 0 |
| Georgia | 0 | 2 | 1 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 5 | 1 | 5 | 1 | 0 | 5 | 16 | 2 |
| Florida | 3 | 17 | 0 | 2 | 14 | 1 | 0 | 10 | 0 | 0 | 9 | 6 | 0 | 9 | 0 | 5 | 59 | 7 |
| Puerto Rico | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| TOTALS | 8 | 38 | 1 | 8 | 34 | 1 | 2 | 21 | 0 | 7 | 26 | 8 | 9 | 23 | 1 | 34 | 142 | 11 |

There were 14 documented strandings of pygmy sperm whales along the U.S. Atlantic coast during 2010–2014 with evidence of human interactions. There were 7 strandings with evidence of human interactions in 2010—3 in Florida, 2 in New Jersey and 2 in South Carolina (1 of them classified as a fishery interaction due to ingested fishing gear, 5 animals ingested plastic, and 1 carcass had some teeth removed by public). In 2011, there were 4 strandings with evidence of human interactions—1 in Virginia (public attempted to move the animal), 1 in Florida (pushed out to sea by public) and 2 in Georgia (plastic ingestion). In 2012 there was 1 stranding in Florida with evidence of human interaction (ingested debris). In 2013 in Georgia there was 1 stranding with evidence of human interaction, and in 2014 in North Carolina there was also 1 stranding with evidence of human interaction (both animals ingested plastic).

Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al*. 2012; Wells *et al*. 2015). Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al*. 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

**STATUS OF STOCK**

Pygmy sperm whales are not listed as threatened or endangered under the Endangered Species Act, and the western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. Total U.S. fishery-related mortality and serious injury for *Kogia* sp. is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of pygmy sperm whales in the U.S. Atlantic EEZ relative to OSP is unknown. There are insufficient data to determine population trends for this species.

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# RISSO'S DOLPHIN (*Grampus griseus*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are distributed worldwide in tropical and temperate seas (Jefferson *et al*. 2008, 2014), and in the Northwest Atlantic occur from Florida to eastern Newfoundland (Leatherwood *et al*. 1976; Baird and Stacey 1991). Off the northeastern U.S. coast, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during spring, summer, and autumn (CETAP 1982; Payne *et al*. 1984) (Figure 1). In winter, the range is in the mid-Atlantic Bight and extends outward into oceanic waters (Payne *et al*. 1984). In general, the population occupies the mid-Atlantic continental shelf edge year round, and is rarely seen in the Gulf of Maine (Payne *et al*. 1984). During 1990, 1991 and 1993, spring/summer surveys conducted along the continental shelf edge and in deeper oceanic waters sighted Risso's dolphins associated with strong bathymetric features, Gulf Stream warm-core rings, and the Gulf Stream north wall (Waring *et al*. 1992, 1993; Hamazaki 2002). There is no information on stock structure of Risso's dolphin in the western North Atlantic, or to determine if separate stocks exist in the Gulf of Mexico and Atlantic. Thus, it is plausible that the stock could actually contain multiple demographically independent populations that should themselves be stocks, because the current stock spans multiple eco-regions (Longhurst 1998; Spalding *et al*. 2007). In 2006, a rehabilitated adult male Risso's dolphin stranded and released in the Gulf of Mexico off Florida was tracked via satellite-linked tag to waters off Delaware (Wells *et al*. 2009). The Gulf of Mexico and Atlantic stocks are currently being treated as two separate stocks.

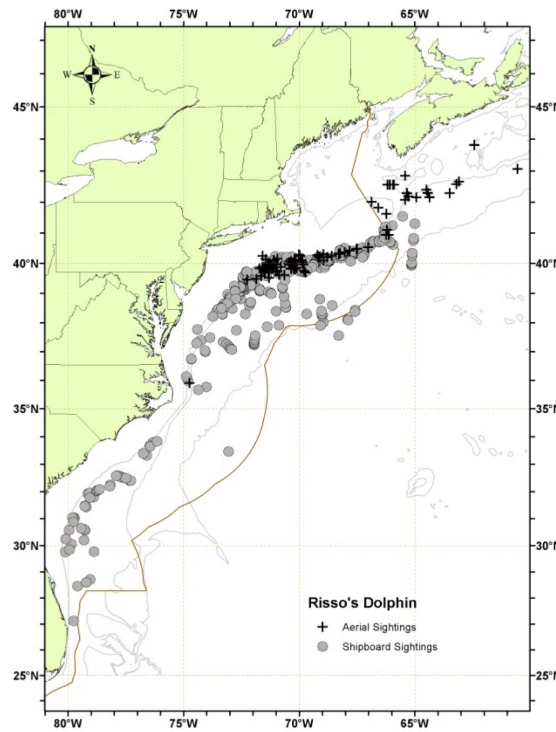


**Figure 1.** *Distribution of Risso's dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008 2010 and 2011. Isobaths are the 100-m, 1,000-m, and 4,000-m depth contours.*

## POPULATION SIZE

The best abundance estimate for Risso's dolphins is the sum of the estimates from the 2011 surveys—18,250 (CV = 0.46).

### Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for the determination of the current PBR.

### Recent surveys and abundance estimates

An abundance estimate of 15,197 (CV = 0.55) Risso's dolphins was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour, through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of central Virginia to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a double-platform data-collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers, 2004). Shipboard data were inspected to determine if there was significant responsive movement to the ship (Palka and Hammond 2001). Because there was evidence of responsive (evasive) movement of this species to the ship, estimation of the abundance was based on Palka and Hammond (2001) and the independent-observer approach assuming full independence (Laake and Borchers 2004), and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

An abundance estimate of 3,053 (CV = 0.44) Risso's dolphins was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida. This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed the double-platform methodology searching with 25×150 "bigeye" binoculars. A total of 4,445 km of tracklines was surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break with generally lower sighting rates over the continental slope. Estimation of the abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Table 1. Summary of recent abundance estimates for the western North Atlantic Risso's dolphin (*Grampus griseus*), by month, year, and area covered during each abundance survey, resulting abundance estimate ($N_{best}$) and coefficient of variation (CV).

| Month/Year | Area | $N_{best}$ | CV |
|---|---|---|---|
| Jun-Aug 2011 | Central Virginia to lower Bay of Fundy | 15,197 | 0.55 |
| Jun-Aug 2011 | Central Florida to Central Virginia | 3,053 | 0.44 |
| Jun-Aug 2011 | Central Florida to lower Bay of Fundy (COMBINED) | 18,250 | 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. This is equivalent to the 20$^{th}$ percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Risso's dolphins is 18,250 (CV = 0.46), obtained from the 2011 surveys. The minimum population estimate for the western North Atlantic Risso's dolphin is 12,619.

### 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

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations 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 is 12,619. The maximum productivity rate is 0.04, the default value for cetaceans (Barlow *et al.* 1995). The recovery factor is 0.5, the default value for stocks of unknown status relative to OSP, and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of

Risso's dolphin is 126.

## ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2010–2014 was 53.6 Risso's dolphins, derived from 2 components: 1) 53 estimated mortalities in observed fisheries (CV = 0.28; Table 2) and 2) 0.6 from average 2010–2014 non-fishery related, human interaction stranding mortalities (NOAA National Marine Mammal Health and Stranding Response Database, accessed 08 October 2015)

### Fishery Information

Detailed fishery information is reported in Appendix III.

### Earlier Interactions

One Risso's dolphin mortality was observed in the mid-Atlantic midwater trawl fishery in 2008. No bycatch estimate was developed, so the 2008 average annual serious injury and mortality attributed to the mid-Atlantic midwater trawl was calculated as a minimum value of 1 animal.

Historically, fishery interactions have been documented with Risso's dolphins in squid and mackerel trawl activities (1977–1991), the pelagic drift gillnet fishery (1989–1998), the pelagic pair trawl fishery (1992), and the mid-Atlantic gillnet fishery (2007). See Appendix V for more information on historical takes.

### Pelagic Longline

Pelagic longline bycatch estimates of Risso's dolphins for 2010–2014 are documented in Garrison and Stokes (2012a, 2012b, 2013, 2014, 2016). Most of the estimated marine mammal bycatch was from U.S. Atlantic EEZ waters between South Carolina and Cape Cod. There is a high likelihood that dolphins released alive with ingested gear or gear wrapped around appendages will not survive (Wells *et al.* 2008). See Table 2 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

One Risso's dolphin was observed taken in northeast bottom trawl fisheries in 2010 and one in 2014 (Table 2). Annual Risso's dolphin mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos 2015).See Table 2 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

Risso's dolphinss have been observed taken in mid-Atlantic bottom trawl fisheries (Table 2). No seriously injured Risso's dolphins have been observed in this fishery. It was discovered in 2010 that a small segment of the mid-Atlantic bottom trawl fleet was equipping fishing nets with acoustic deterrent devices (i.e., pingers). To the extent possible, the use of pingers on bottom trawl gear has been taken into account when estimating bycatch mortality of Risso's dolphins (methodology is detailed in Lyssikatos 2015). Annual Risso's dolphin mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos 2015). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

### Northeast Sink Gillnet

In the northeast sink gillnet fishery, Risso's dolphin interactions have historically been rare, but in 2012 and 2013 one animal was observed each year in the waters south of Massachusetts (Hatch and Orphanides 2014, 2015, 2016*)*. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Table 2. Summary of the incidental serious injury and mortality of Risso's dolphin (*Grampus griseus*) by commercial fishery including the years sampled, the type of data used, the annual observer coverage, the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury, the estimated CV of the combined estimates and the mean of the combined estimates (CV in parentheses).

| Fishery | Years | Data Type [a] | Observer Coverage [b] | Observed Serious Injury | Observed Mortality | Estimated Serious Injury[e] | Estimated Mortality | Estimated Combined Mortality | Estimated CVs | Mean Combined Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Pelagic Longline [c] | 10-14 | Obs. Data Logbook | .08, .09, .07, .09 | 0, 2, 1, 1, 1 | 0, 0, 0, 0, 0 | 0, 12, 15, 1.9, 7.7 | 0, 0, 0, 0. 0 | 0, 12, 15, 1.9, 7.7 | 0, .63, 1.0, 1.0, 1.0 | 7.3 (0.52) |
| Northeast Sink Gillnet | 10-14 | Obs. Data, Trip Logbook, Allocated Dealer Data | 0.17, .19, .15, .11, .18 | 0, 0, 0, 0, 0 | 0, 0, 1, 1, 0 | 0, 0, 0, 0, 0 | 0, 0, 6, 23, 0 | 0, 0, 6, 23, 0 | 0, 0, .87, 1, 0 | 5.8 (0.79) |
| Northeast Bottom Trawl[c] | 10-14 | Obs. Data Dealer Data VTR Data | .16, .26, .17, .15, .17 | 0, 0, 0, 0, 0 | 1, 0, 0, 0, 1 | 0, 0, 0, 0, 0 | 2, 3, 0, 0, 4.2 | 2, 3, 0, 0, 4.2 | .55, .55, 0, 0, .91 | 1.8 (0.47) |
| Mid-Atlantic Bottom Trawl [d] | 10-14 | Obs. Data Dealer Data | .06, .08, .05, .06, .08 | 0, 0, 0, 0 , 0 | 15, 2, 1, 4, 2 | 0, 0, 0, 0 , 0 | 54, 62, 7, 46, 21 | 54, 62, 7, 46, 21 | .74, .56, 1.0, .71, .93 | 38 (.35) |
| TOTAL | | | | | | | | | | 53 (0.28) |

a Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (unallocated Dealer Data and Allocated Dealer Data) which are used as a measure of total landings and mandatory Vessel Trip Reports (VTR) (Trip Logbook) are used to determine the spatial distribution of landings and fishing effort. Total landings are used as a measure of total effort for the coastal gillnet fishery.

b The observer coverages for the northeast and mid-Atlantic sink gillnet fishery are ratios based on tons of fish landed. Northeast bottom trawl, mid-Atlantic bottom trawl, northeast mid-water and mid-Atlantic mid-water trawl fishery coverages are ratios based on trips. Total observer coverage reported for gillnet and bottom trawl gear in the years starting in 2010 include samples collected from traditional fisheries observers in addition to fishery at-sea monitors through the Northeast Fisheries Observer Program (NEFOP). For 2010 only the NEFOP observed data were reported in this table, since the at-sea monitoring program just started in May 2010. Both at-sea monitor and traditional fisheries observer data were used for 2011 and onwards.

c Estimates can include data pooled across years, so years without observed SI or Mortality may still have an estimated value.

d Fishery related bycatch rates were estimated using an annual stratified ratio-estimator.

e Waring et al. 2014,2015, Wenzel *et al*. 2015, 2016.

**Other Mortality**

From 2010 to 2014, 30 Risso's dolphin strandings were recorded along the U.S. Atlantic coast (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 08 October 2015). Five animals had indications of human interaction, 2 of which were fishery interactions. Indications of human interaction are not necessarily the cause of death (Table 3).

Table 3. Risso's dolphin (*Grampus griseus*) reported strandings along the U.S. Atlantic coast and Puerto Rico, 2010-2014.

| STATE | 2010 | 2011 | 2012 | 2013 | 2014 | TOTALS |
|---|---|---|---|---|---|---|
| Maine | 0 | 0 | 0 | 0 | 0 | 0 |
| Massachusetts[a] | 0 | 0 | 0 | 3 | 2 | 5 |
| New York | 0 | 1 | 0 | 2 | 0 | 3 |
| New Jersey | 0 | 0 | 0 | 0 | 0 | 0 |
| Maryland | 1 | 0 | 0 | 1 | 0 | 2 |
| Virginia[b] | 4 | 1 | 0 | 0 | 1 | 6 |
| North Carolina[c] | 2 | 1 | 2 | 1 | 1 | 7 |
| Georgia | 0 | 0 | 0 | 0 | 0 | 0 |
| Florida | 0 | 2 | 2 | 2 | 0 | 6 |
| Puerto Rico | 0 | 1 | 0 | 0 | 0 | 1 |
| TOTAL | **7** | **6** | **4** | **9** | **4** | **30** |

a. One animal in 2014 was classified as human interaction due to signs of ear trauma.

b. One animal in 2014 classified as HI due to plastic injestion.

c. One animal in 2010 classified as human interaction due to beach mutilation. Two animals in 2012 showed signs of fishery interaction.

Stranding data probably underestimate the extent of fishery-related 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.

## STATUS OF STOCK

Risso's dolphins are not listed as threatened or endangered under the Endangered Species Act and the Western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. The 2010–2014 average annual human-related mortality does not exceed PBR. The total U.S. fishery mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching a zero mortality and serious injury rate. The status of Risso's dolphins relative to OSP in the U.S. Atlantic EEZ is unknown. Population trends for this species have not been investigated.

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# LONG-FINNED PILOT WHALE (*Globicephala melas melas*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of pilot whales in the western Atlantic—the long-finned pilot whale, *Globicephala melas melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea and cannot be reliably visually identified during either abundance surveys or observations of fishery mortality without high-quality photographs (Rone and Pace 2012); therefore, the ability to separately assess the two species in U.S. Atlantic waters is complex and requires additional information on seasonal spatial distribution. The long-finned pilot whale is distributed from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea (Sergeant 1962; Leatherwood *et al.* 1976; Abend 1993; Bloch *et al.* 1993; Abend and Smith 1999). The stock structure of the North Atlantic population is uncertain (ICES 1993; Fullard *et al.* 2000). Morphometric (Bloch and Lastein 1993) and genetic (Siemann 1994; Fullard *et al.* 2000) studies have provided little support for stock separation across the Atlantic (Fullard *et al.* 2000). However, Fullard *et al.* (2000) have proposed a stock structure that is related to sea-surface temperature: 1) a cold-water population west of the Labrador/North Atlantic current, and 2) a warm-water population that extends across the Atlantic in the Gulf Stream.

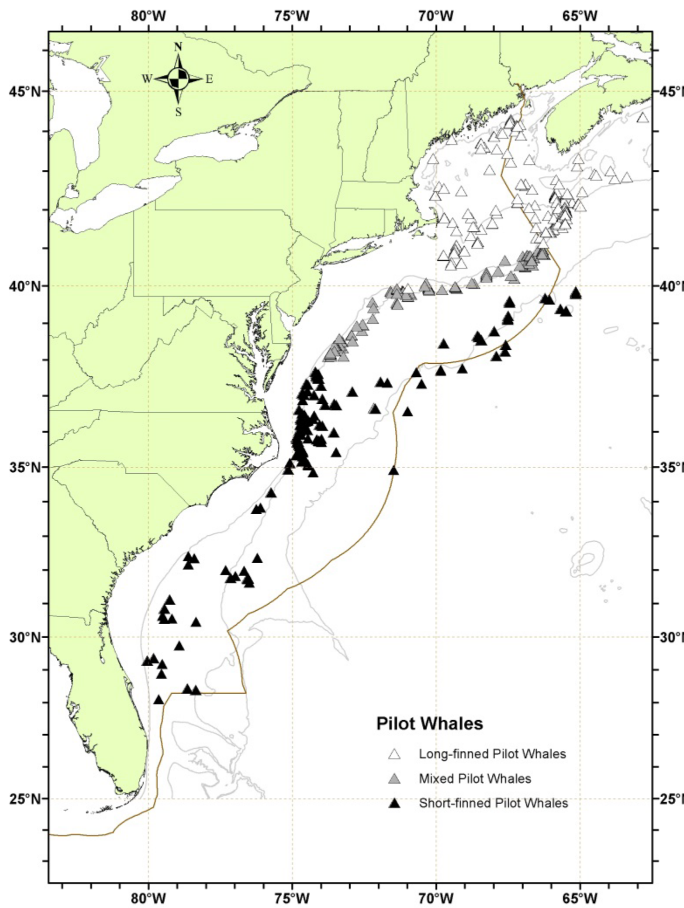


Figure 1. *Distribution of long-finned (open symbols), short-finned (black symbols), and possible mixed (gray symbols; could be either species) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, 2007 and 2011. The inferred distribution of the two species is preliminary and is valid for June-August only. Isobaths are the 100-m, 1,000-m, and 4,000-m depth contours.*

In U.S. Atlantic waters, pilot whales (*Globicephala* sp.) are distributed principally along the continental shelf edge off the northeastern U.S. coast in winter and early spring (CETAP 1982; Payne and Heinemann 1993; Abend and Smith 1999; Hamazaki 2002). In late spring, pilot whales move onto Georges Bank and into the Gulf of Maine and more northern waters, and remain in these areas through late autumn (CETAP 1982; Payne and Heinemann 1993). Pilot whales tend to occupy areas of high relief or submerged banks. They are also associated with the Gulf Stream wall and thermal fronts along the continental shelf edge (Waring *et al.* 1992). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Payne and Heinemann 1993; Rone and Pace 2012). Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina, and short-finned pilot whales have occasionally been observed stranded as far north as Massachusetts. The latitudinal ranges of the two species therefore remain uncertain, although south of Cape Hatteras, most pilot whale sightings are expected to be short-finned pilot whales, while north of ~42°N most pilot whale sightings are expected to be long-finned pilot whales (Figure 1).

## POPULATION SIZE

The best available estimate for long-finned pilot whales in the western North Atlantic is 5,636 (CV=0.63; Table 1; Palka 2012). This estimate is from summer 2011 surveys covering waters from central Virginia to the lower Bay of Fundy. It should be noted, however, that these surveys did not include areas of the Scotian Shelf where the highest densities of pilot whales were observed in the summer of 2006, therefore they represent an underestimate of the overall abundance of this stock. Because long-finned and short-finned pilot whales are difficult to distinguish at sea, sightings data are reported as *Globicephala sp*. These survey data have been combined with an analysis of the spatial distribution of the 2 species based on genetic analyses of biopsy samples to derive separate abundance estimates (Garrison and Rosel 2017).

### Earlier estimates

Please see appendix IV for a summary of abundance estimates including earlier estimates and survey descriptions. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for the determination of the current PBR. Due to changes in survey methodology, these historical data should not be used to make comparisons with more current estimates.

### Recent surveys and abundance estimates for *Globicephala* sp.

An abundance estimate of 11,865 (CV=0.57) *Globicephala* sp. was generated from aerial and shipboard surveys conducted during June–August 2011 between central Virginia and the lower Bay of Fundy (Palka 2012). The aerial portion covered 6,850 km of tracklines over waters north of New Jersey between the coastline and the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. Pilot whales were not observed during the aerial portion of the survey. The shipboard portion covered 3,811 km of tracklines between central Virginia and Massachusetts in waters deeper than the 100-m depth contour out to beyond the U.S. Exclusive Economic Zone (EEZ). Both sighting platforms used a double-platform data-collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). The vessel portion of this survey included habitats where both short-finned and long-finned pilot whales occur. A logistic regression (see next section) was used to estimate the abundance of long-finned pilot whales from this survey as 5,636 (CV=0.63).

An abundance estimate of 16,946 (CV=0.43) *Globicephala* sp. was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida (Garrison 2016). This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed two independent visual teams searching with 25× bigeye binoculars. A total of 4,445 km of tracklines was surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break north of Cape Hatteras, North Carolina, with a lower number of sightings over the continental slope in the southern portion of the survey. Estimation of pilot whale abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). This survey included habitats where only short-finned pilot whales are expected to occur.

### Spatial Distribution and Abundance Estimates for *Globicephala melas*

Biopsy samples from pilot whales were collected during summer months (June–August) from South Carolina to the southern flank of Georges Bank between 1998 and 2007. These samples were identified to species using genetic analysis of mitochondrial DNA sequences. A portion of the mtDNA genome was sequenced from each biopsy sample collected in the field, and genetic species identification was performed through phylogenetic reconstruction of the haplotypes. Stranded specimens that were morphologically identified to species were used to assign clades in the phylogeny to species and thereby identify all samples. The probability of a sample being from a long-finned (or short-finned) pilot whale was evaluated as a function of sea-surface temperature and water depth using logistic regression. This analysis indicated that the probability of a sample coming from a long-finned pilot whale was near 1 at water temperatures <22°C, and near 0 at temperatures >25°C. The probability of a long-finned pilot whale also decreased with increasing water depth. Spatially, during summer months, this regression model predicts that all pilot whales observed in offshore waters near the Gulf Stream are most likely short-finned pilot whales. The area of overlap between the 2 species occurs primarily along the shelf break off the coast of New Jersey between 38°N and

40°N latitude (Garrison and Rosel 2017). This model was used to partition the abundance estimates from surveys conducted during the summer of 2011. The sightings from the southeast shipboard survey covering waters from Florida to central Virginia were predicted to consist entirely of short-finned pilot whales. The aerial portion of the northeast surveys covered the Gulf of Maine and the Bay of Fundy and surveys where the model predicted that only long-finned pilot whales would occur, but no pilot whales were observed. The vessel portion of the northeast survey recorded a mix of both species along the shelf break, and the sightings in offshore waters near the Gulf Stream were predicted to consist predominantly of short-finned pilot whales (Garrison and Rosel 2017). The abundance estimate for long-finned pilot whales from the northeast summer 2011 vessel survey was 5,636 (CV=0.63; Palka 2012). The summer 2011 aerial survey of the Gulf of Maine to the Bay of Fundy did not include areas of the Scotian Shelf where the highest densities of pilot whales were observed in the summer of 2006, therefore the 2011 summer surveys are an underestimate of the overall abundance of this stock.

Table 1. Summary of recent abundance estimates for the western North Atlantic long-finned pilot whale (*Globicephala melas melas*) by 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 2011 | central Virginia to Lower Bay of Fundy | 5,636 | 0.63 |

**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 western North Atlantic long-finned pilot whales is 5,636 animals (CV=0.63). The minimum population estimate for long-finned pilot whales is 3,464.

**Current Population Trend**

A trend analysis has not been conducted for this stock. There are 2 abundance estimates for *Globicephala* spp. from summer 1998 (14,909; CV=0.26) and summer 2004 surveys (31,139; CV=0.27), and 1 abundance estimate of *G. melas* from summer 2011 surveys (5,636; CV=0.63). Because the 1998 and 2004 surveys did not derive separate abundance estimates for each pilot whale species, comparisons to the 2011 estimate are inappropriate.

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations 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 long-finned pilot whales is 3,464. The maximum productivity rate is 0.04, the default value for cetaceans. The “recovery” factor is 0.5 because this stock is of unknown status relative to optimum sustainable population (OSP) and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic long-finned pilot whale is 35.

**ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

Total annual observed average fishery-related mortality or serious injury during 2010–2014 was 38 for long-finned pilot whales (CV=0.15; see Table 2). In bottom trawls and mid-water trawls and in the gillnet fisheries, mortalities were more generally observed north of 40°N latitude and in areas expected to have only long-finned pilot whales. Takes in these fisheries were therefore attributed to the long-finned pilot whales. Takes in the pelagic longline fishery were partitioned according to a logistic regression model (Garrison and Rosel 2017).

**Fishery Information**

The commercial fisheries that could potentially interact with this stock in the Atlantic Ocean are the Category I northeast sink gillnet and the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fisheries; and the

Category II northeast bottom trawl and northeast mid-water trawl (including pair trawl) fisheries. Detailed fishery information is reported in Appendix III.

**Earlier Interactions**

Historically, fishery interactions have been documented with pilot whales in the Atlantic pelagic drift gillnet fishery, Atlantic tuna pair trawl and tuna purse seine fisheries, northeast and mid-Atlantic gillnet fisheries, northeast and mid-Atlantic bottom trawl fisheries, northeast midwater trawl fishery, and the pelagic longline fishery. See Appendix V for more information on historical takes.

**Northeast Sink Gillnet**

One pilot whale was caught in this fishery in 2010. According to modeled species distribution, this whale was a long-finned pilot whale. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

**Longline**

Most of the estimated marine mammal bycatch in the U.S. pelagic longline fishery was recorded in U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Garrison 2007). During 2010–2013, all observed interactions and estimated bycatch in the pelagic longline fishery was assigned to the short-finned pilot whale stock because the observed interactions all occurred at times and locations where available data indicated that long-finned pilot whales were very unlikely to occur. Specifically, the highest bycatch rates of undifferentiated pilot whales were observed during September–November along the mid-Atlantic coast (south of 40°N; Garrison 2007), and biopsy data collected in this area during October–November 2011 indicated that only short-finned pilot whales occurred in this region (Garrison and Rosel 2017). Similarly, all genetic data collected from interactions in the pelagic longline fishery have indicated interactions with short-finned pilot whales. However, during 2014, 4 pilot whale interactions (all serious injuries) occurred along the southern flank of Georges Bank. No samples were collected from these animals. Therefore, the logistic regression model (described above in 'Spatial Distribution and Abundance Estimates for *Globicephala melas*') was applied to estimate the probability that these 2014 interactions were from short-finned vs. long-finned pilot whales (Garrison and Rosel 2017). Due to high water temperatures (approximately 25ºC) along the southern flank of Georges Bank at the time of the observed takes, these interactions were estimated to have a >80% probability of coming from short-finned pilot whales. The estimated probability was used to apportion the estimated serious injury and mortality from 2014 in the pelagic longline fishery between the short-finned and long-finned pilot whale stocks. The estimated serious injury and mortality for the short-finned pilot whale was 233 (CV=0.24), and that for long-finned pilot whales was 9.6 (CV=0.43; Garrison and Stokes 2016). See Table 2 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**

In addition to takes observed by fisheries observers, the Marine Mammal Authorization Program (MMAP) (http://www.nmfs.noaa.gov/pr/interactions/mmap/) included 2 self-reported incidental takes (mortalities) in trawl gear off Maine and Rhode Island during 2011. Self-reported takes were not used in the estimation process and are not reported in Table 2. Fishery-related bycatch rates for years 2010–2014 were estimated using an annual stratified ratio-estimator (Lyssikatos 2015). These mortality estimates replace the 2008–2011 annual estimates reported in the 2013 stock assessment report that were generated using a different method described in Rossman (2010). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

**Northeast Mid-Water Trawl (Including Pair Trawl)**

In September 2011, one pilot whale was taken in the northeast mid-water trawl fishery on the northern flank of Georges Bank. Another pilot whale was taken in a mid-water trawl in 2012. Three were taken in 2013 near the western edge of Georges Bank. Four were taken in 2014. Using model-based predictions and at-sea identification, these takes have all been assigned as long-finned pilot whales. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed takes per observed hours the gear was in the water) for each year, where the paired and single northeast mid-water trawls were pooled and only hauls that targeted herring or mackerel were used. The VTR herring and mackerel data were used to estimate the total effort (NMFS unpublished data). Estimated annual fishery-related mortalities were 0 in 2010 (Table 2). Expanded estimates of fishery mortality for 2011- 2014 are not available, and so for those years the raw number is provided. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

**CANADA**

Unknown numbers of long-finned pilot whales have been taken in Newfoundland, Labrador, and Bay of Fundy groundfish gillnets; Atlantic Canada and Greenland salmon gillnets; and Atlantic Canada cod traps (Read 1994).

Table 2. Summary of the incidental mortality and serious injury of long-finned pilot whales (*Globicephala melas melas.*) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Est. CVs) and the mean of the combined estimates (CV in parentheses). These are minimum observed counts as expanded estimates are not available.

| Fishery | Years | Data Type[a] | Observer Coverage[b] | Observed Serious Injury [d] | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Est. CVs | Mean Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Sink Gillnet | 10-14 | Obs. Data, Logbook, Dealer Data | .17, .19, .15, .11, .18 | 0, 0, 0, 0, 0 | 1, 0, 0, 0, 0 | 0, 0, 0, 0, 0 | 3, 0, 0, 0, 0 | 3, 0, 0, 0, 0 | 82, 0, 0, 0, 0 | 0.6 (0.82) |
| Northeast Bottom Trawl [b] | 10-14 | Obs. Data, Logbook | .16, .26, .17. .15 | 1,3,3,0, 1 | 9,9,7,4, 4 | 6, 12, 10, 0, 6 | 24, 43, 23, 16, 25 | 30, 55, 33, 16, 32 | .43, .18, .32, .42, .44 | 33.2 (0.15) |
| Northeast Mid-Water Trawl - Including Pair Trawl [c] | 10-14 | Obs. Data, Dealer Data, VTR Data | .41, .17, .45, .37, .42 | 0, 0, 0, 0, 0 | 0,1, 1, 3, 4 | 0, 0, 0, 0, 0 | ,0, 1, 1, 3, 4 | 0, 1, 1, 3, 4 | na, na, na, na, na | 1.8 (na) |
| Pelagic Longline Fishery | 10-14 | Obs. Data, Logbook Data | .08, .09, .07, .09, .10 | 0,0,0,0,1 | 0,0,0,0,0 | 0,0,0,0,9.6 | 0,0,0,0,0 | 0,0,0,0,0,9.6 | na, na, na, na, .43 | 1.9 (0.43) |
| TOTAL | | | | | | | | | | 38 (0.15) |

[a] Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program (NEFOP). NEFSC collects landings data (unallocated Dealer Data and Allocated Dealer Data) which are used as a measure of total landings and mandatory Vessel Trip Reports (VTR) (Trip Logbook) are used to determine the spatial distribution of landings and fishing effort. Total landings are used as a measure of total effort for the coastal gillnet fishery.

[b] The observer coverages for the northeast sink gillnet fishery are ratios based on tons of fish landed. Northeast bottom trawl and northeast mid-water trawl fishery coverages are ratios based on trips. Total observer coverage reported for gillnet and bottom trawl gear in the years starting in 2010 include samples collected from traditional fisheries observers in addition to fishery at-sea monitors through the Northeast Fisheries Observer Program (NEFOP). For 2010 only the NEFOP observed data were reported in this table, since the at-sea monitoring program just started in May 2010. Both at-sea monitor and traditional fisheries observer data were used for 2011 and onwards

[c] Expanded estimates for 2010–2014 are not available for this fishery.

[d] Waring et al. 2014,2015, Wenzel *et al*. 2015, 2016.

**Other Mortality**

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. From 2010 to 2014, 27 long-finned pilot whales (*Globicephala melas melas*), and 5 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including the EEZ (Table 3).

Long-finned pilot whales have been reported stranded as far south as Florida, where 2 long-finned pilot whales were reported stranded in November 1998, though their flukes had been apparently cut off, so it is unclear where these animals actually may have died. One additional long-finned pilot whale stranded in South Carolina in 2003, though the confidence in the species identification at the time was only moderate. A genetic sample from this animal has subsequently been sequenced and mitochondrial DNA analysis supports the long-finned pilot whale identification.

During 2010–2014, several human and/or fishery interactions were documented in stranded pilot whales within the U.S. EEZ. Two long-finned pilot whale stranding mortalities in 2011 in Massachusetts were classified as human interaction cases, one due to onlookers trying to refloat the animal, and another with tow rope around the tail most likely tied on postmortem.

Table 3. Pilot whale *Globicephala melas melas* [LF] *and Globicephala* sp. [Sp]) strandings along the Atlantic coast, 2010-2014. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

| STATE | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LF | Sp | LF | Sp | LF | Sp | LF | Sp | LF | Sp | LF | Sp |
| Nova Scotia[a] | 0 | 11 | 0 | 19 | 0 | 3 | 15 | 0 | 0 | 0 | 15 | 33 |
| Newfoundland and Labrador[b] | 0 | 1 | 0 | 8 | 0 | 6 | 1 | 1 | 0 | 1 | 1 | 17 |
| Maine | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 4 | 0 |
| Massachusetts[c] | 2 | 0 | 4 | | 3 | | 3 | | 1 | | 13 | 0 |
| Rhode Island | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| New York | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 5 | 0 |
| New Jersey | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| Maryland | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| Virginia | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| South Carolina | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| TOTALS - U.S. & EEZ | 2 | 3 | 8 | 1 | 6 | 1 | 7 | 0 | 4 | 0 | 27 | 5 |

[a] Data supplied by Nova Scotia Marine Animal Response Society (pers. comm.). Strandings in 2011 include one mass stranding of 6-8 whales (one of which died) and 2 animals with ropes tied around their tail stocks. Strandings in 2013 include one fishery entanglement (bait net) and one mass stranding of 4 animals.
[b] (Ledwell and Huntington 2010, 2011, 2012, 2013, 2014). 2011 included 2 mom/calf pairs. Not included in 2011 total was group of 6 pilot whales shepherded out of a narrow channel.
[c] One of the 2010 animals released alive.

Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury, particularly for offshore species such as pilot whales, because not all of the whales that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al*. 2012; Wells *et al*. 2015). 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.

## HABITAT ISSUES

A potential human-caused source of mortality is from polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.), moderate levels of which have been found in pilot whale blubber (Taruski *et al.* 1975; Muir *et al.* 1988; Weisbrod *et al.* 2000). Weisbrod *et al.* (2000) reported that bioaccumulation levels were more similar in whales from the same stranding group than in animals of the same sex or age. Also, high levels of toxic metals (mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Island drive fishery (Nielsen *et al.* 2000). Similarly, Dam and Bloch (2000) found very high PCB levels in pilot whales in the Faroes. The population effect of the observed levels of such contaminants is unknown.

**STATUS OF STOCK**

The long-finned pilot whale is not listed as threatened or endangered under the Endangered Species Act, but the western North Atlantic stock is considered strategic under the MMPA because the mean annual human-caused mortality and serious injury exceeds PBR. Total U.S. fishery-related mortality and serious injury for long-finned pilot whales is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this stock.

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# SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

There are 2 species of pilot whales in the western North Atlantic - the long-finned pilot whale, *Globicephala melas melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea and cannot be reliably visually identified during either abundance surveys or observations of fishery mortality without high-quality photographs (Rone and Pace 2012); therefore, the ability to separately assess the 2 species in U.S. Atlantic waters is complex and requires additional information on seasonal spatial distribution. Undifferentiated pilot whales (*Globicephala* sp.) in the western North Atlantic occur primarily near the continental shelf break ranging from Florida to the Nova Scotia Shelf (Mullin and Fulling 2003). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Payne and Heinemann 1993; Rone and Pace 2012). Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina, and short-finned pilot whales have occasionally been observed stranded as far north as Massachusetts. The latitudinal ranges of the two species therefore remain uncertain, although south of Cape Hatteras, most pilot whale sightings are expected to be short-finned pilot whales, while north of ~42°N most pilot whale sightings are expected to be long-finned pilot whales (Figure 1). In addition, short-finned pilot whales are documented along the continental shelf and continental slope in the northern Gulf of Mexico (Hansen *et al.* 1996; Mullin and Hoggard 2000; Mullin and Fulling 2003), and they are also known from the wider Caribbean. A May 2011 mass stranding of 23 short-finned pilot whales in the Florida Keys has been considered to be Gulf of Mexico stock whales based on stranding location, yet two tagged and released individuals from this stranding travelled directly into the Atlantic (Wells *et al.* 2013). Studies are currently being conducted at the Southeast Fisheries Science Center to evaluate genetic population structure in short-finned pilot whales. Pending these results, the *Globicephala macrorhynchus* population occupying U.S. Atlantic waters is considered separate from both the northern Gulf of Mexico stock and short-finned pilot whales occupying

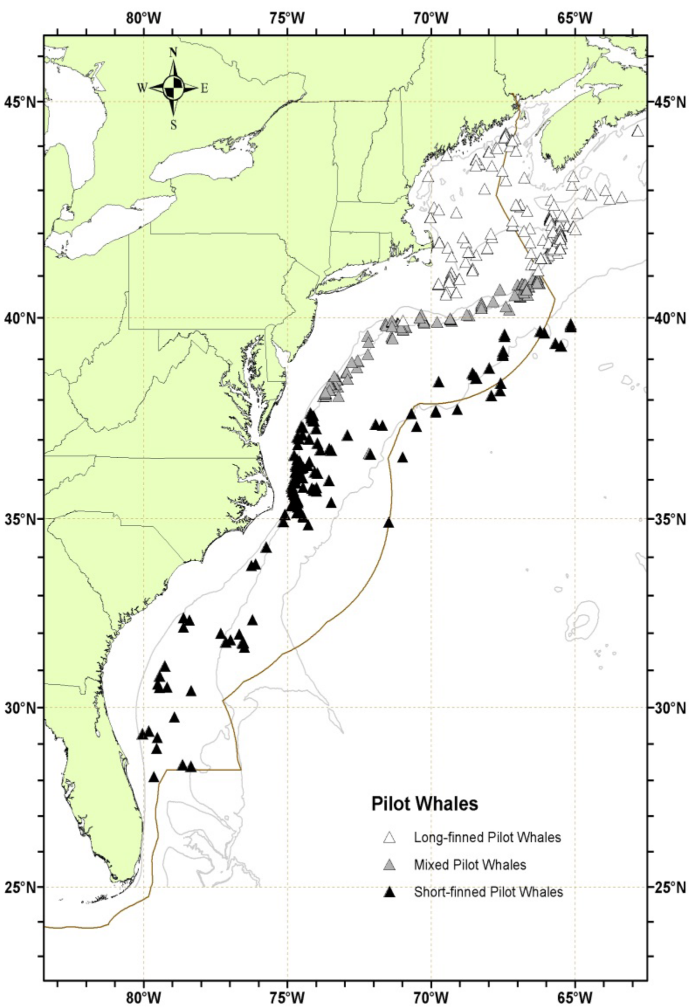


Figure 1. *Distribution of long-finned (open symbols), short-finned (black symbols), and possibly mixed (gray symbols; could be either species) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, 2007 and 2011. The inferred distribution of the two species is preliminary and is valid for June-August only. Isobaths are the 100-m, 1,000-m, and 4,000-m depth contours.*

Caribbean waters.

## POPULATION SIZE

The best available estimate for short-finned pilot whales in the western North Atlantic is 21,515 (CV=0.37; Table 1; Palka 2012; Garrison 2016). This estimate is from summer 2011 surveys covering waters from central Florida to the lower Bay of Fundy. Sightings from vessel and aerial surveys were strongly concentrated along the continental shelf break; however, pilot whales were also observed over the continental slope in waters associated with the Gulf Stream (Figure 1). The best available abundance estimates are from aerial and shipboard surveys conducted during the summer of 2011 because these are the most recent surveys covering the full range of pilot whales in U.S. Atlantic waters. Because long-finned and short-finned pilot whales are difficult to distinguish at sea, sightings data are reported as *Globicephala sp*. These survey data have been combined with an analysis of the spatial distribution of the 2 species based on genetic analyses of biopsy samples to derive separate abundance estimates (Garrison and Rosel 2017).

### Earlier Estimates

Please see Appendix IV for a summary of abundance estimates including earlier estimates and survey descriptions. Due to changes in survey methodology, these historical data should not be used to make comparisons with more current estimates. In addition, as recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable for the determination of a current PBR.

### Recent surveys and abundance estimates for *Globicephala* sp.

An abundance estimate of 11,865 (CV=0.57) *Globicephala* sp. was generated from aerial and shipboard surveys conducted during June–August 2011 between central Virginia and the lower Bay of Fundy (Palka 2012). The aerial portion covered 6,850 km of trackline over waters north of New Jersey between the coastline and the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. Pilot whales were not observed during the aerial portion of the survey. The shipboard portion covered 3,811 km of trackline between central Virginia and Massachusetts in waters deeper than the 100-m depth contour out to beyond the U.S. Exclusive Economic Zone (EEZ). Both sighting platforms used a double-platform data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). The vessel portion of this survey included habitats where both short-finned and long-finned pilot whales occur. A logistic regression (see next section) was used to estimate the abundance of short-finned pilot whales from this survey as 4,569 (CV=0.57).

An abundance estimate of 16,946 (CV=0.43) *Globicephala* sp. was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida (Garrison 2016). This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed two independent visual teams searching with 25x150 "bigeye" binoculars. A total of 4,445 km of trackline was surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break north of Cape Hatteras, North Carolina, with a lower number of sightings over the continental slope in the southern portion of the survey. Estimation of pilot whale abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). This survey included habitats that are expected to exclusively contain short-finned pilot whales.

### Spatial Distribution and Abundance Estimates for *Globicephala macrorhynchus*

Pilot whale biopsy samples were collected during summer months (June–August) from South Carolina to the southern flank of Georges Bank between 1998 and 2007. These samples were identified to species using genetic analysis of mitochondrial DNA sequences. A portion of the mtDNA genome was sequenced from each biopsy sample collected in the field, and genetic species identification was performed through phylogenetic reconstruction of the haplotypes. Samples from stranded specimens that were morphologically identified to species were used to assign clades in the phylogeny to species and thereby identify all survey samples. The probability of a sample being from a short-finned (or long-finned) pilot whale was evaluated as a function of sea surface temperature and water depth using logistic regression. This analysis indicated that the probability of a sample coming from a short-finned pilot whale was near 0 at water temperatures <22°C, and near 1 at temperatures >25°C. The probability of a short-finned pilot whale also increased with increasing water depth. Spatially, during summer months, this regression model predicts that all pilot whales observed in offshore waters near the Gulf Stream are most likely short-finned pilot whales. The area of overlap between the 2 species occurs primarily along the shelf break off the coast of New Jersey between 38°N and 40°N latitude (Garrison and Rosel 2017). This model was used to partition the abundance estimates from surveys conducted during the summer of 2011. The sightings from the southeast shipboard survey covering waters from Florida to central Virginia were predicted to consist entirely of short-finned pilot whales. The aerial portion of the northeast surveys covered the Gulf of Maine and the Bay of Fundy where the model predicted that only long-finned pilot whales would occur, but no pilot whales were observed. The vessel portion of the northeast survey included waters along the shelf break and waters further offshore extending to the U.S. EEZ. Pilot whales were observed in both areas during the survey. Along the shelf break, the model predicted a mixture of both species, but the sightings in offshore waters near the Gulf Stream were predicted to consist predominantly of short-finned pilot whales (Garrison and Rosel 2017). The best abundance estimate for short-finned pilot whales is thus the sum of the southeast survey estimate (16,946; CV=0.43) and the estimated number of short-finned pilot whales from the northeast vessel survey (4,569; CV=0.57). The best available abundance estimate is thus 21,515 (CV=0.37).

Table 1. Summary of recent abundance estimates for the western North Atlantic short-finned pilot whale (*Globicephala macrorhynchus*) by 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 2011 | central Virginia to Lower Bay of Fundy | 4,569 | 0.57 |
| Jun–Aug 2011 | central Florida to central Virginia | 16,946 | 0.43 |
| Jun–Aug 2011 | central Florida to lower Bay of Fundy (COMBINED) | 21,515 | 0.37 |

### 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 western North Atlantic *Globicephala macrorhnychus* is 21,515 animals (CV=0.37). The minimum population estimate is 15,913.

### Current Population Trend

A trend analysis has not been conducted for this stock. There are 2 abundance estimates for *Globicephala* spp. from summer 1998 (14,909; CV=0.26) and summer 2004 surveys (31,139; CV=0.27), and 1 abundance estimate of *G. macrorhynchus* from summer 2011 surveys (21,515; CV=0.37). Because the 1998 and 2004 surveys did not derive separate abundance estimates for each pilot whale species, comparisons to the 2011 estimate are inappropriate.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations 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 short-finned pilot whales is 15,913. The maximum productivity rate is 0.04, the default value for cetaceans. The “recovery” factor is 0.5 because the 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 western North Atlantic short-finned pilot whale is 159.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated mean annual fishery-related mortality and serious injury during 2010–2014 due to the pelagic longline fishery was 192 short-finned pilot whales (CV=0.17; Table 2). The total annual fishery-related mortality and serious injury for this stock during 2010–2014 is unknown because in addition to observed takes in the pelagic longline fishery, there was a self-reported take in the unobserved hook and line fishery in 2013.

During 2010–2013, all observed interactions and estimated bycatch was assigned to the short-finned pilot whale stock because the observed interactions all occurred at times and locations where available data indicated that long-finned pilot whales were very unlikely to occur. Specifically, the highest bycatch rates of undifferentiated pilot whales were observed during September–November along the mid-Atlantic coast (south of 40°N; Garrison 2007), and biopsy data collected in this area during October–November 2011 indicated that only short-finned pilot whales occurred in this region (Garrison and Rosel 2017). Similarly, all genetic data collected from interactions in the pelagic longline fishery have indicated interactions with short-finned pilot whales. However, during 2014, 4 pilot whale interactions (all serious injuries) occurred along the southern flank of Georges Bank. No samples were collected from these animals. Therefore, the logistic regression model (described above in 'Spatial Distribution and Abundance Estimates for *Globicephala macrorhynchus*') was applied to estimate the probability that these 2014 interactions were from short-finned vs. long-finned pilot whales (Garrison and Rosel 2017). Due to high water temperatures (approximately 25ºC) along the southern flank of Georges Bank at the time of the observed takes, these interactions were estimated to have a >80% probability of coming from short-finned pilot whales. The estimated probability was used to apportion the estimated serious injury and mortality from 2014 in the pelagic longline fishery between the short-finned and long-finned pilot whale stocks. The estimated serious injury and mortality for the short-finned pilot whale was 233 (CV=0.24), and that for long-finned pilot whales was 9.6 (CV=0.43; Garrison and Stokes 2016).

In bottom trawl, mid-water trawl, and gillnet fisheries, mortalities were observed north of 40°N latitude and in areas expected to have only long-finned pilot whales. Takes and bycatch estimates for these fisheries are therefore attributed to the long-finned pilot whale stock.

**Fishery Information**

The commercial fisheries that interact, or that potentially could interact, with this stock in the Atlantic Ocean are the Category I Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline and Atlantic Highly Migratory Species longline fisheries; and the Category III U.S. Atlantic tuna purse seine and Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fisheries. All recent gillnet and trawl interactions have been assigned to long-finned pilot whales using model-based predictions. Detailed fishery information is reported in Appendix III.

**Earlier Interactions**

See Appendix V for information on historical takes.

**Longline**

The large pelagics longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ, and pelagic swordfish, tunas and billfish are the target species. The estimated annual average serious injury and mortality attributable to the Atlantic Ocean large pelagics longline fishery for the 5-year period from 2010 to 2014 was 192 short-finned pilot whales (CV=0.17; Table 2). During 2010–2014, 69 serious injuries were observed in the following fishing areas of the North Atlantic: Florida East Coast, Mid-Atlantic Bight, Northeast Coastal, and South Atlantic Bight. During 2010–2014, 1 mortality was observed (in 2011) in the Mid-Atlantic Bight fishing area (Garrison and Stokes 2012a,b; 2013; 2014; 2016).

Most of the estimated marine mammal bycatch in the U.S. pelagic longline fishery was recorded in U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Garrison 2007). January–March observed bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras, North Carolina. During April–June, bycatch was recorded in this area as well as north of Hydrographer Canyon in water over 1,000 fathoms (1830 m) deep. During the July–September period, observed takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October–December bycatch occurred between the 20- and 50-fathom (37- and 92-m) isobaths between Barnegat Bay, New Jersey and Cape Hatteras, North Carolina.

The Atlantic Highly Migratory Species longline fishery operates outside the U.S. EEZ. No takes of short-finned pilot whales within high seas waters of the Atlantic Ocean have been observed or reported thus far.

See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical estimates of annual mortality and serious injury.

Table 2. Summary of the incidental mortality and serious injury of short-finned pilot whales (*Globicephala macrorhynchus*) by the pelagic longline commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the annual observed serious injury and mortality recorded by on-board observers, the annual estimated serious injury and mortality, the combined annual estimates of serious injury and mortality (Estimated Combined Mortality), the estimated CV of the combined annual mortality estimates (Est. CVs) and the mean of the combined mortality estimates (CV in parentheses).

| Fishery | Years | Vessels [a] | Data Type [b] | Observer Coverage [c] | Observed Serious Injury | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Est. CVs | Mean Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pelagic Longline | 2010 – 2014 | 80, 83,82, 79,78 | Obs. Data, Logbook | .08, .09, .07, .09, .10 | 5, 18, 14, 13, 19 | 0, 1, 0, 0, 0 | 127, 286, 170, 124, 233 | 0, 19, 0, 0, 0 | 127, 305, 170, 124, 233 | .78, .29, .33, .32, .24 | 192 (.17) |

[a] Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.
[b] Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program (NEFOP) and the Southeast Pelagic Longline Observer Program.
[c] Proportion of sets observed

**Hook and Line**

During 2010–2014, there was 1 self-reported take (in 2013) in which a short-finned pilot whale was hooked and entangled by a charterboat fisherman. The animal was released alive but considered seriously injured (Maze-Foley and Garrison 2016).

**Other Mortality**

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along the eastern U.S. seaboard since 1980 (NMFS 1993, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From 2010–2014, 45 short-finned pilot whales (*Globicephala macrorhynchus*) and 6 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Massachusetts and Florida, including the EEZ (Table 3).

Table 3. Short-finned pilot whale (*Globicephala macrorhynchus* [SF] *and Globicephala* sp. [Sp]) strandings along the Atlantic coast, 2010–2014. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

| STATE | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SF | Sp | SF | Sp | SF | Sp | SF | Sp | SF | Sp | SF | Sp |
| Massachusetts | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| New Jersey | 0 | 0 | 1[a] | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Virginia | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| North Carolina | 1[b] | 0 | 1[b] | 0 | 1[b] | 0 | 0 | 0 | 3 | 0 | 6 | 0 |
| South Carolina | 0 | 1 | 0 | 0 | 3[c] | 1 | 1 | 0 | 2 | 0 | 6 | 2 |
| Florida | 4 | 0 | 2 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 29 | 0 |

| TOTALS | 5 | 3 | 7 | 1 | 27 | 1 | 1 | 0 | 5 | 0 | 45 | 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [a] Signs of human interaction were observed for this short-finned pilot whale stranding.<br>[b] Signs of fishery interaction were observed for these short-finned pilot whale strandings.<br>[c] Signs of fishery interaction were observed for 2 of these short-finned pilot whale strandings. | | | | | | | | | | | | |

Short-finned pilot whales strandings (*Globicephala macrorhynchus*) have been reported as far north as Block Island, Rhode Island (2001), and Cape Cod, Massachusetts (2011), although the majority of the strandings occurred from North Carolina southward (Table 3).

During 2010–2014, several human interactions, including some that were fishery interactions, were documented in stranded pilot whales along the U.S. Atlantic coast. A short-finned pilot whale stranded in North Carolina in 2010 had evidence of longline interaction. In 2011, a short-finned pilot whale in North Carolina was classified as a fishery interaction and a short-finned pilot whale in New Jersey was found with a healed but abscessed bullet wound. In 2012, 3 short-finned pilot whales had evidence of fishery interactions, 2 of them in South Carolina and 1 in North Carolina. During 2013–2014, no evidence of human interactions was documented for stranded pilot whales.

Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury, particularly for offshore species such as pilot whales, because not all of the whales that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al*. 2012; Wells *et al*. 2015). 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.

## HABITAT ISSUES

A potential human-caused source of mortality is from polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.), moderate levels of which have been found in pilot whale blubber (Taruski *et al.* 1975; Muir *et al.* 1988; Weisbrod *et al.* 2000). Weisbrod *et al.* (2000) reported that bioaccumulation levels were more similar in whales from the same stranding group than in animals of the same sex or age. Also, high levels of toxic metals (mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Island drive fishery (Nielsen *et al.* 2000). Similarly, Dam and Bloch (2000) found very high PCB levels in pilot whales in the Faroes. The population effect of the observed levels of such contaminants is unknown.

## STATUS OF STOCK

The short-finned pilot whale is not listed as threatened or endangered under the Endangered Species Act, but the western North Atlantic stock is considered strategic under the MMPA because the mean annual human-caused mortality and serious injury exceeds PBR. Total U.S. fishery-related mortality and serious injury attributed to short-finned pilot whales exceeds 10% of the calculated PBR and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this stock.

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# ATLANTIC WHITE-SIDED DOLPHIN (*Lagenorhynchus acutus*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

White-sided dolphins are found in temperate and sub-polar waters of the North Atlantic, primarily in continental shelf waters to the 100-m depth contour. In the western North Atlantic the species inhabits waters from central West Greenland to North Carolina (about 35˚N) and perhaps as far east as 29˚W in the vicinity of the mid-Atlantic Ridge (Evans 1987; Hamazaki 2002; Doksaeter *et al.* 2008; Waring *et al.* 2008). Distribution of sightings, strandings and incidental takes suggest the possible existence of three stock units: Gulf of Maine, Gulf of St. Lawrence and Labrador Sea stocks (Palka *et al.* 1997). Evidence for a separation between the population in the southern Gulf of Maine and the Gulf of St. Lawrence population comes from the reduced density of summer sightings along the Atlantic side of Nova Scotia. This was reported in Gaskin (1992), is evident in Smithsonian stranding records and in Canadian/west Greenland bycatch data (Stenson *et al.* 2011) and was obvious during summer abundance surveys that covered waters from Virginia to the Gulf of St. Lawrence and during the Canadian component of the Trans-North Atlantic Sighting Survey in the summer of 2007 (Lawson and Gosselin 2009, 2011). White-sided dolphins were seen frequently in Gulf of Maine waters and in waters at the mouth of the Gulf of St. Lawrence, but only a relatively few sightings were recorded between these two regions. This trend is less obvious since 2007.

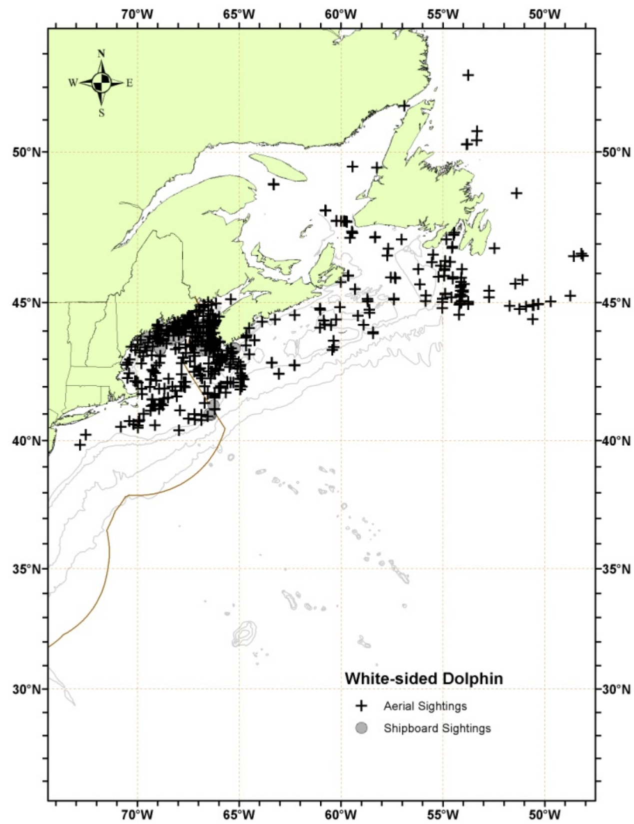


**Figure 1**. *Distribution of white-sided dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011, and DFO's 2007 TNASS survey. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

The Gulf of Maine population of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39˚N) to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy. Sighting data indicate seasonal shifts in distribution (Northridge *et al.* 1997). During January to May, low numbers of white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire), with even lower numbers south of Georges Bank, as documented by a few strandings collected on beaches of Virginia to South Carolina. From June through September, large numbers of white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, white-sided dolphins occur at intermediate densities from southern Georges Bank to southern Gulf of Maine (Payne and Heinemann 1990). Sightings south of Georges Bank, particularly around Hudson Canyon, occur year round but at low densities. The Virginia and North Carolina observations appear to represent the southern extent of the species' range during the winter months. On 4 May 2008 a stranded 17-year old male white-sided dolphin with severe pulmonary distress and reactive lymphadenopathy stranded in South Carolina (Powell *et al.* 2012). In the absence of additional strandings or sightings, this stranding seems to be an out-of-range anomaly. The seasonal spatial distribution of this species appears to be changing during the last few years. There is evidence for an earlier distributional shift during the 1970s, from primarily offshore waters into the Gulf of Maine, hypothesized to be related to shifts in abundance of pelagic fish stocks resulting from depletion of herring by foreign distant-water fleets (Kenney *et al.* 1986).

Recent stomach-content analysis of both stranded and incidentally caught white-sided dolphins in U.S. waters determined that the predominant prey were silver hake (*Merluccius bilinearis*), spoonarm octopus (*Bathypolypus* *bairdii*) and haddock (*Melanogrammus aeglefinus*). Sand lances (*Ammodytes* spp.) were only found in the stomach of one stranded white-sided dolphin. Seasonal variation in diet was indicated; pelagic Atlantic herring (*Clupea harengus*) was the most important prey in summer, but was rare in winter (Craddock *et al.* 2009).

## POPULATION SIZE

The best available current abundance estimate for white-sided dolphins in the western North Atlantic stock is 48,819 (CV= 0.61), resulting from a June–August 2011survey.

### Earlier abundance estimates

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable to determine the current PBR.

### Recent surveys and abundance estimates

An abundance estimate of 48,819 (CV=0.61) white-sided dolphins was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of central Virginia to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a double-platform data-collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers, 2004). Estimation of the abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the MRDS option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

No white-sided dolphins were detected in the aerial and ship abundance surveys that were conducted concurrently (June-August 2011) in waters between central Virginia and central Florida. This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed the double-platform methodology searching with 25x150 "bigeye" binoculars. A total of 4,445 km of tracklines was surveyed, yielding 290 cetacean sightings.

Table 1. Summary of recent abundance estimates for western North Atlantic stock of white-sided dolphins (*Lagenorhynchus acutus*) , by 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 2011 | Central Virginia to lower Bay of Fundy | 48,819 | 0.61 |

### 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 white-sided dolphins is 48,819 (CV=0.61). The minimum population estimate for these white-sided dolphins is 30,403.

### 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

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: calving interval is 2-3 years; lactation period is 18 months; gestation period is 10–12 months and births occur from May to early August, mainly in June and July; length at birth is 110 cm; length at sexual maturity is 230–240 cm for males, and 201–222 cm for females; age at sexual maturity is 8–9 years for males and 6–8 years for females; mean adult length is 250 cm for males and 224 cm for females (Evans 1987); and maximum reported age for males is 22 years and for females, 27 years (Sergeant *et al.* 1980).

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 is 30,403. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5 , the default value for stocks of unknown status relative to OSP, and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of white-sided dolphin is 304.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2010–2014 was 77 (CV=0.2) white-sided dolphins (Table 2).

### Fishery Information

Detailed fishery information is reported in Appendix III.

### Earlier Interactions

Historically, fishery interactions have been documented with white-sided dolphins in the Joint Venture and Foreign Atlantic mackerel fishery (1977–1991), the Atlantic pelagic drift gillnet fishery (1991–1998), the U.S. J.V midwater (pelagic) trawl fishery (2001), the mid-Atlantic gillnet fishery (1997), Northeast midwater pair trawls (2002, 2005), and the mid-Atlantic bottom trawl (1997, 2005, 2007). See Appendix V for more information on historical takes.

### U.S.

### Northeast Sink Gillnet

Annual white-sided dolphin mortalities were estimated using annual ratio-estimator methods (Table 2; Orphanides 2013; Hatch and Orphanides 2014, 2015, 2016). Recently white-sided dolphin bycatch has occurred mostly in the Gulf of Maine, with a few south of Cape Cod. Bycatch occurred nearly year round, though mostly in the winter and summer. There are large inter-annual differences in the magnitude of the level of bycatch, which may be due to inter-annual differences in the number of white-sided dolphins using the Gulf of Maine, as has been seen in the series of past abundance estimates for this species. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for long-term bycatch information.

### Northeast Bottom Trawl

Fishery-related bycatch rates for years 2009–2013 were estimated using an annual stratified ratio-estimator (Lyssikatos 2015). Between 2008 and 2013, all white-sided dolphin bycatch occurred in the Gulf of Maine and Georges Bank eco-regions, primarily during the winter (January–April) season when sea surface temperatures are less than 10° C. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for long-term bycatch information.

### Mid-Atlantic Bottom Trawl

Fishery-related bycatch rates were estimated using an annual stratified ratio-estimator (Lyssikatos 2015). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for long-term bycatch information.

Table 2. Summary of the incidental mortality of North Atlantic stock of white-sided dolphins (*Lagenorhynchus acutus*) by commercial fishery including the years sampled, the type of data used, the annual observer coverage, the serious injuries and mortalities recorded by on-board observers, the estimated annual serious injury and mortality, the estimated CV of the combined annual mortality and the mean annual mortality (CV in parentheses).

| Fishery | Years | Data Type [a] | Observer Coverage [b] | Observed Serious Injury | Observed Mortality | Estimated Serious Injury[d] | Estimated Mortality | Estimated Combined Mortality | Estimated CVs | Mean Combined Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Sink Gillnet[c] | 10-14 | Obs. Data Weighout Trip Logbook | .17, .19, .15, .11, .18 | 1, 0, 0, 0, 0 | 6, 5, 1, 1, 2 | 4, 1, 0, 0, 0 | 62, 17, 9, 4, 10 | 66,18, 9, 4, 10 | .90, .43, .92, 1.03, .66 | 21 (0.57) |
| Northeast Bottom Trawl | 10-14 | Obs. Data Trip Logbook | .16, .26, 0.17, .15, 17 | 0, 2, 0, 0, 0 | 10, 47, 9, 8, 3 | 1, 3, 0, 0, 0 | 36, 138, 27, 33, 16 | 37, 140, 27, 33, 16 | .32, .24, .47, .31, .5 | 51 (0.16) |
| Mid-Atlantic Bottom Trawl | 10-14 | Obs. Data Trip Logbook | .06, .08, .05, .06, .08 | 0, 0, 0, 0, 0 | 0, 0, 0, 0,1 | 0, 0, 0, 0, 0 | 0, 0, 0, 0, 9.67 | 0, 0, 0, 0, 9.67 | 0, 0, 0, 0, .94 | 1.9 (.94) |
| Total | | | | | | | | | | 74 (0.2) |

a Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Observer Program and At-sea Monitoring Program. NEFSC collects landings data (unallocated Dealer Data or Allocated Dealer Data) which are used as a measure of total landings and mandatory Vessel Trip Reports (VTR) (Trip Logbook) are used to determine the spatial distribution of landings and fishing effort in the sink gillnet, bottom trawl and mid-water trawl fisheries. In addition, the Trip Logbooks are the primary source of the measure of total effort (tow duration) in the mid-water and bottom trawl fisheries.

b Observer coverage is defined as the ratio of observed to total metric tons of fish landed for the gillnet fisheries ,.and the ratio of observed to total trips for bottom trawl and Mid-Atlantic mid-water trawl (including pair trawl) fisheries. Beginning in May 2010 total observer coverage reported for bottom trawl and gillnet gear includes samples collected from the at-sea monitoring program in addition to traditional observer coverage through the Northeast Fisheries Observer Program (NEFOP).

c After 1998, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within the stratum where white-sided dolphins were observed taken. During the years 1997, 1999, 2001, 2002, and 2004, respectively, there were 2, 1, 1, 1, and 1 observed white-sided dolphins taken on pingered trips. No takes were observed on pinger trips during 1995, 1996, 1998, 2000, 2005 through 2007. Three of the 2008 takes were on non-pingered hauls and the fourth take was recorded as pinger condition unknown. Of the six 2010 observed takes, 4 were in pingered nets and 2 in non-pingered nets. Four of the 2011 takes were in pingered nets. The 2012 take was in a non-pingered net. The 2013 take was in a pingered net. In 2010, both observed mortalities were in pingered nets.

d Waring *et al.* 2014,2015, Wenzel *et al*. 2015, 2016.

**CANADA**

There is little information available that quantifies fishery interactions involving white-sided dolphins in Canadian waters. Two white-sided dolphins were reported caught in groundfish gillnet sets in the Bay of Fundy during 1985 to 1989, and 9 were reported taken in West Greenland between 1964 and 1966 in the now non-operational salmon drift nets (Gaskin 1992). Several (number not specified) were also taken during the 1960s in the now non-operational Newfoundland and Labrador groundfish gillnets. A few (number not specified) were taken in an experimental drift gillnet fishery for salmon off West Greenland which took place from 1965 to 1982 (Read 1994).

Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on 25-40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. Bycaught marine mammals were noted as weight in kilos rather than by the numbers of animals caught. Thus the number of individuals was estimated by dividing the total weight per species per trip by the maximum recorded weight of each species. During 1991 through 1996, an estimated 6 white-sided dolphins were observed taken. One animal was from a longline trip south of the Grand Banks (43º 10'N 53º 08'W) in November 1996 and the other 5 were taken in the bottom trawl fishery off Nova Scotia in the Atlantic Ocean; 1 in July 1991, 1 in April 1992, 1 in May 1992, 1 in April 1993, 1 in June 1993 and 0 in 1994 to 1996.

Estimation of small cetacean bycatch for Newfoundland fisheries using data collected during 2001 to 2003 (Benjamins *et al.* 2007) indicated that, while most of the estimated 862 to 2,228 animals caught were harbor porpoises, a few were white-sided dolphins caught in the Newfoundland nearshore gillnet fishery and offshore monkfish/skate gillnet fisheries.

**Herring Weirs**

Previously only one white-sided dolphin was released alive and unharmed from a herring weir in the Bay of Fundy (A. Westgate, pers. comm.). Due to the formation of a cooperative program between Canadian fishermen and biologists, it is expected that most dolphins and whales will be able to be released alive. Fishery information is available in Appendix III.

**Other Mortality**

**U.S.**

During 2010–2014 there were 130 documented Atlantic white-sided dolphin strandings on the U.S. Atlantic coast (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 08 October 2015). Thirty of these animals were released alive. Human interaction was indicated in 5 records during this period. Of these, one was classified as a fishery interaction.

Mass strandings involving up to a hundred or more animals at one time are common for this species. The causes of these strandings are not known. Because such strandings have been known since antiquity, it could be presumed that recent strandings are a normal condition (Gaskin 1992). It is unknown whether human causes, such as fishery interactions and pollution, have increased the number of strandings. In an analysis of mortality causes of stranded marine mammals on Cape Cod and southeastern Massachusetts between 2000 and 2006, Bogomolni *et al.* (2010) found 69% (46 of 67) of stranded white-sided dolphins were involved in mass-stranding events with no significant cause determined, and 21% (14 of 67) were classified as disease-related.

Stranding data probably underestimate the extent of fishery-related 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.

**CANADA**

The Nova Scotia Stranding Network documented whales and dolphins stranded on the coast of Nova Scotia during 1991 to 1996 (Hooker *et al.* 1997). Researchers with Dept. of Fisheries and Oceans, Canada documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). More recently whales and dolphins stranded on the coast of Nova Scotia have been recorded by the Marine Animal Response Society and the Nova Scotia Stranding Network (Table 3; Marine Animal Response Society, pers. comm.). In addition, stranded white-sided dolphins in Newfoundland and Labrador are being recorded by the Whale Release and Strandings Program (Table 3; Ledwell and Huntington 2010, 2011, 2012a, 2012b, 2013, 2014).

Table 3. White-sided dolphin (*Lagenorhynchus acutus*) reported strandings along the U.S. and Canadian Atlantic coast, 2010-2014.

| Area | Year | | | | | Total |
|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 | |
| Maine | 1 | 2 | 1 | 1 | 2 | 7 |
| New Hampshire | 0 | 0 | 2 | 0 | 0 | 2 |
| Massachusetts[a,b] | 50 | 42 | 3 | 10 | 2 | 107 |
| Rhode Island | 0 | 1 | 1 | 1 | 0 | 3 |
| Connecticut | 0 | 0 | 0 | 0 | 0 | 0 |
| New York | 1 | 0 | 3 | 2 | 0 | 6 |
| New Jersey | 0 | 1 | 0 | 0 | 0 | 1 |
| Delaware | 0 | 1 | 0 | 0 | 0 | 1 |
| Maryland | 0 | 1 | 0 | 0 | 0 | 1 |
| Virginia | 0 | 0 | 0 | 0 | 0 | 0 |
| North Carolina | 0 | 1 | 0 | 0 | 0 | 1 |
| South Carolina | 0 | 0 | 0 | 0 | 0 | 0 |
| Georgia | 0 | 1 | 0 | 0 | 0 | 1 |
| **TOTAL US** | **52** | **50** | **10** | **14** | **4** | **130** |
| Nova Scotia[c] | 2 | 6 | 5 | 7 | 12 | 32 |
| Newfoundland and Labrador[d] | 2 | 0 | 3 | 0 | 5 | 10 |
| **GRAND TOTAL** | **56** | **56** | **18** | **21** | **21** | **172** |

[a] Records of mass strandings in Massachusetts during this period are: March 2010 - 7 animals (one dead calf, 6 adults released alive), 16 animals (5 dead, 11 released alive) and 3 animals (one released alive); April 2010 - 2 animals (released alive); July 2010 - 2 animals (released alive); March 2011 - 4 animals (2 released alive), 2 animals (released alive); April 2013 - 2 animals (one released alive); December 2013 - 3 animals (all released alive).

[b] In 2010, 2 animals in Massachusetts were classified as human interactions, 1 of them a fishery interaction. In 2011, 1 animal in Massachusetts was classified as human interaction due to post-mortem mutilation. In 2014, 1 animal in Massachusetts was classified as human interaction due to attempts by public to return animal to sea. In 2014, 1 animal in Maine was classified as human interaction due to plastics injestion.

[c] Data supplied by Nova Scotia Marine Animal Response Society (pers. comm.). 2014 data include a mass stranding of 7 animals all released alive and a single animal released alive.

[d] (Ledwell and Huntington 2010,2011, 2012a, 2012b, 2013, 2014, 2015).

## STATUS OF STOCK

White-sided dolphins are not listed as threatened or endangered under the Endangered Species Act. The Western North Atlantic stock of white-sided dolphins is not considered strategic under the Marine Mammal Protection Act. The estimated average annual human-related mortality does not exceed PBR but is not less than 10% of the calculated PBR; therefore, it cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of white-sided dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. A trend analysis has not been conducted for this species.

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# COMMON DOLPHIN (*Delphinus delphis delphis*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The common dolphin (*Delphinus delphis delphis*) may be one of the most widely distributed species of cetaceans, as it is found world-wide in temperate and subtropical seas. In the North Atlantic, common dolphins are commonly found along the shoreline of Massachusetts in mass-stranding events (Bogomolni et al. 2010; Sharp et al. 2014), as well as found over the continental shelf between the 100-m and 2000-m isobaths and over prominent underwater topography and east to the mid-Atlantic Ridge (29˚W) (Doksaeter *et al.* 2008; Waring *et al*. 2008) and are associated with Gulf Stream features (CETAP 1982; Selzer and Payne 1988; Waring *et al.* 1992; Hamazaki 2002). The species is less common south of Cape Hatteras, although schools have been reported as far south as the Georgia/South Carolina border (32º N) (Jefferson *et al*. 2009). They have seasonal movements where they are found from Cape Hatteras northeast to Georges Bank (35˚ to 42˚N) during mid-January to May (Hain *et al.* 1981; CETAP 1982; Payne *et al.* 1984) though some animals tagged and released after stranding in winters of 2010-2012 used habitat in the Gulf of Maine north to almost 44˚ (Sharp *et al*. 2016). Common dolphins move onto Georges Bank, Gulf of Maine, and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. Common dolphins were occasionally found in the Gulf of Maine (Selzer and Payne 1988), more often in the last few years (Figure 1). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11ºC (Sergeant *et al.* 1970; Gowans and Whitehead 1995).

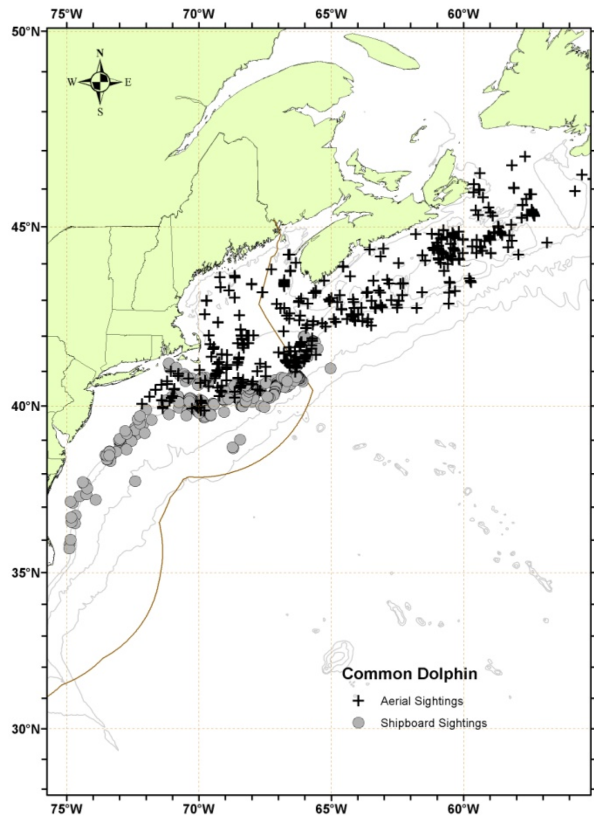


**Figure 1**. *Distribution of common dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, 2007, 2010 and 2011 and DFO's 2007 TNASS survey. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

Westgate (2005) tested the proposed one-population-stock model using a molecular analysis of mitochondrial DNA (mtDNA), as well as a morphometric analysis of cranial specimens. Both genetic analysis and skull morphometrics failed to provide evidence ($p>0.05$) of more than a single population in the western North Atlantic, supporting the proposed one-stock model. However, when western and eastern North Atlantic common dolphin mtDNA and skull morphology were compared, both the cranial and mtDNA results showed evidence of restricted gene flow ($p<0.05$) indicating that these two areas are not panmictic. Cranial specimens from the two sides of the North Atlantic differed primarily in elements associated with the rostrum. These results suggest that common dolphins in the western North Atlantic are composed of a single panmictic group whereas gene flow between the western and eastern North Atlantic is limited (Westgate 2005, 2007).

## POPULATION SIZE

The current best abundance estimate for common dolphins off the U.S. Atlantic coast is 70,184 (CV=0.28). This estimate, derived from 2011 shipboard and aerial surveys, is the only current estimate available. This estimate is substantially lower than the estimate from the previous (2015) SAR. This is because the previous estimate included data from the 2007 TNASS surveys of Canadian waters. For the purposes of this SAR, as recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, so this new estimate must not include data from the 2007 TNASS survey. This new estimate should not be interpreted as a decline in abundance of this stock, as previous estimates are not directly comparable.

**Earlier estimates**

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable to determine a current PBR.

**Recent surveys and abundance estimates**

An abundance estimate of 67,191 (CV=0.29) common dolphins was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the estimate covered 5,313 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines between central Virginia and Massachusetts in waters deeper than the 100-m depth contour out to beyond the U.S. EEZ. Both sighting platforms used a double-platform data-collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the MRDS option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

An abundance estimate of 2,993 (CV=0.87) common dolphins was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida. This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed a double-platform visual team procedure searching with 25×150 "bigeye" binoculars. A total of 4,445 km of tracklines was surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break with generally lower sighting rates over the continental slope. Estimation of the abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Table 1. Summary of recent abundance estimates for western North Atlantic common dolphin (*Delphinus delphis delphis*) by 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 |
|---|---|---|---|
| Jul-Aug 2011 | Central Virginia to lower Bay of Fundy | 67,191 | 0.29 |
| Jun-Aug 2011 | Central Florida to Central Virginia | 2,993 | 0.87 |
| Jun-Aug 2011 | Central Florida to lower Bay of Fundy (COMBINED) | 70,184 | 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. 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 common dolphins is 70,184 animals (CV=0.28), derived from the 2011 aerial and shipboard surveys. The minimum population estimate for the western North Atlantic common dolphin is 55,690.

**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

Current and maximum net productivity rates are unknown for this stock. Life history parameter information that could be used to estimate net productivity are there is a peak in parturition during July and August with an average birth day of 28 July. Gestation lasts about 11.7 months and lactation lasts at least a year. Given these results western North Atlantic female common dolphins are likely on a 2-3 year calving interval. Females become sexually mature earlier (8.3 years and 200 cm) than males (9.5 years and 215 cm) as males continue to increase in size and mass. There is significant sexual dimorphism present with males being on average about 9% larger in body length (Westgate 2005; Westgate and Read 2007).

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 is 55,690 animals. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5, the default value for stocks of unknown status and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of common dolphin is 557.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2010–2014 was 409 (CV=0.10) common dolphins.

### Fishery information

Detailed fishery information is reported in Appendix III.

### Earlier Interactions

Historically, US fishery interactions have been documented with common dolphins in the northeast and mid-Atlantic gillnet fisheries, northeast and mid-Atlantic bottom trawl fisheries, northeast and mid-Atlantic mid-water trawl fishery, and the pelagic longline fishery. See Appendix V for more information on historical takes.

### Northeast Sink Gillnet

In 1990, an observer program was started by NMFS to investigate marine mammal takes in the northeast sink gillnet fishery (Appendix III). Common dolphin bycatch in the northern Gulf of Maine occurs primarily from June to September, while in the southern Gulf of Maine, bycatch occurs from January to May and September to December. Annual common dolphin mortalities were estimated using annual ratio-estimator methods (Orphanides 2013; Hatch and Orphanides 2014, 2015, 2016). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

A study of the effects of two different hanging ratios in the bottom-set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010 with 100% observer coverage. Commercial fishing vessels from Massachusetts and New Jersey were used for the study, which took place south of the Harbor Porpoise Take Reduction Team Cape Cod South Management Area (south of 40° 40´N) in February–April. Researchers purposely picked an area of historically high bycatch rates in order to have a chance of finding a significant difference. Eight research strings of fourteen nets each were fished and 159 hauls were completed during the course of the 2009–2010 study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh, there was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios. One common dolphin was caught in this study south of New England in 72 hauls during 2009 and one animal was caught in 72 hauls during the 2010 experiment in the mid-Atlantic (A.I.S., Inc. 2010). The 2010 take is in the time period of this report and is included in the observed interactions and added to the total estimates in Table 2, although these animals and the fishing effort from this experiment were not included in the estimation of the bycatch rate that was expanded to the rest of the fishing effort.

### Mid-Atlantic Gillnet

Common dolphins were taken in observed trips during most years. Annual common dolphin mortalities were estimated using annual ratio-estimator methods (Orphanides 2013; Hatch and Orphanides 2014, 2015, 2016). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

A study of the effects of tie-downs and bycatch rates of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) in both control and experimental gillnet gear operating in Statistical Area 612 (off New York and New Jersey) between 14 November and 18 December 2010 had 100% observer coverage. This experimental fishery captured 6 common dolphins and 3 unidentified dolphins (unidentified due to lack of photos) during this time period (Fox *et al.* 2011). These 6 takes are included in the observed interactions and added to the total estimates, though these interactions and their associated fishing effort were not included in bycatch rate calculations that was expanded to the rest of the fishery (Table 2).

**Northeast Bottom Trawl**

This fishery is active in New England waters in all seasons. Annual common dolphin mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos 2015).See Table 2 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 common dolphin mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos 2015). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

**Northeast Mid-water Trawl Fishery (Including Pair Trawl)**

A common dolphin mortality was observed in this fishery in 2010, and another in 2012 (Table 2). An expanded bycatch estimate has not been calculated so the minimum raw count is reported.

Table 2. Summary of the incidental serious injury and mortality of North Atlantic common dolphins (*Delphinus delphis delphis*) by commercial fishery including the years sampled, the type of data used, the annual observer coverage, the serious injuries and mortalities recorded by on-board observers, the estimated annual serious injury and mortality, the combined serious injury and mortality estimate, the estimated CV of the annual combined serious injury and mortality and the mean annual serious injury and mortality estimate (CV in parentheses).

| Fishery | Years | Data Type[a] | Observer Coverage[b] | Observed Serious Injury[e] | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Estimated CVs | Mean Annual Combined Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Sink Gillnet[d] | 10-14 | Obs. Data, Trip Logbook, Allocated Dealer Data | .17, .19, .15, .11, .18 | 0, 0, 0, 0, 0 | 4, 6, 6, 5, 11 | 0, 0, 0, 0, 0 | 69, 49, 95, 104, 111 | 69, 49, 95, 104, 111 | .81, .71, .40, .46, .47 | 83 (.24) |
| Mid-Atlantic Gillnet[d] | 10-14 | Obs. Data, Trip Logbook, Allocated Dealer Data | .04, .02, .02, .03, .05 | 0, 0, 0, 0, 0 | 10, 3, 1, 2, 1 | 0, 0, 0, 0, 0 | 30, 29, 15, 62, 17 | 30, 29, 15, 62, 17 | .48, .53, .93, .67, .86 | 31(.33) |
| Northeast Mid-water Trawl - Including Pair Trawl | 10-14 | Obs. Data Trip Logbook | .54, .41, .45, .37, .42 | 0, 0, 0, 0, 0 | 1, 0, 1, 0, 0 | 0, 0, 0, 0, 0 | na, 0, na, 0, 0 | 1, 0, 1, 0, 0 | 1, 0, 1, 0, 0 | 0.4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Bottom Trawl[c] | 10-14 | Obs. Data Trip Logbook | .16, .26, .17, .15, .17 | 2, 0, 0, 0, 0 | 29, 22, 10, 4, 3 | 3, 2, 0, 0, 0 | 111, 70, 40, 17, 17 | 114, 72, 40, 17, 17 | .32, .37, .54, .54, .53 | 52 (.2) |
| Mid-Atlantic Bottom Trawl[c] | 10-14 | Obs. Data Trip Logbook | .06, .08, .05, .06, .08 | 0, 1, 0, 0, 3 | 2, 29, 32, 24, 35 | 1, 8, 7, 0, 24 | 20, 263, 316, 269, 305 | 21, 271, 323, 269, 329 | .96, .25, .26, .29, .29 | 243(.14) |
| TOTAL | | | | | | | | | | 409 (.1) |

a. Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Fisheries Observer Program and At-sea Monitoring Program. NEFSC collects landings data (unallocated Dealer Data or Allocated Dealer Data) which are used as a measure of total landings and mandatory Vessel Trip Reports (VTR) (Trip Logbook) are used to determine the spatial distribution of landings and fishing effort.

b. Observer coverage is defined as the ratio of observed to total metric tons of fish landed for the gillnet fisheries ,.and the ratio of observed to total trips for bottom trawl and Mid-Atlantic mid-water trawl (including pair trawl) fisheries. Beginning in May 2010 total observer coverage reported for bottom trawl and gillnet gear includes samples collected from the at-sea monitoring program in addition to traditional observer coverage through the Northeast Fisheries Observer Program (NEFOP).

c. Fishery related bycatch rates for years 2010-2014 were estimated using an annual stratified ratio-estimator (Lyssikatos 2015).

d. One common dolphin was incidentally caught in 2010 in the mid-Atlantic gillnet fishery as part of a NEFSC hanging ratio study to examine the impact of gillnet hanging ratio on harbor porpoise bycatch. Six common dolphins were caught in a study of the effects of tie-downs on Atlantic Sturgeon bycatch rates conducted in the mid-Atlantic gillnet fishery in 2010. All research takes are included in the observed interactions and added to the total estimates, though these interactions and their associated fishing effort were not included in bycatch rate calculations that was expanded to the rest of the fishery.

e. Serious injuries were evaluated for the 2010–2014 period using new guidelines and include both at-sea monitor and traditional observer data (Waring *et al.* 2014, 2015Wenzel *et al*. 2015, 2016)

**CANADA**

Between January 1993 and December 1994, 36 Spanish deep-water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Banks) (Lens 1997). A total of 47 incidental catches was recorded, which included one common dolphin. The incidental mortality rate for common dolphins was 0.007/set. One common dolphin was reported as a bycatch mortality in Canadian bottom otter trawl fishing on Georges Bank in 2012 (pers. comm. Marine Animal Response Society, Nova Scotia).

**Other Mortality**

From 2010 to 2014, 698 common dolphins were reported stranded between Maine and Florida (Table 3). The total includes mass-stranded common dolphins in Massachusetts during 2010 (a total of 30 in 8 events), 2011 (a total of 30 animals in 5 events), 2012 (23 group stranding events), 2013 (a total of 9 in 3 events), and 2014 (a total of 14 in 4 events) ,one mass stranding in North Carolina in 2011 (4 animals), and 2 mass strandings in Virginia in 2013 (a total of 6 in 2 events). Eleven animals in 2010, 15 animals in 2011, 71 animals in 2012, 13 in 2013 and 12 in 2014 were released or last sighted alive. In 2010, 7 animals were classified as human interactions, 2 of which were fishery interactions (all Massachusetts mass-stranded animals) and 2 of which (Rhode Island) involved animals last sighted free-swimming. In 2011, 3 animals were classified as having human interactions, 2 of which were fishery interactions (one of these was satellite-tagged and released). Twelve human interaction cases were reported in 2012 (7 in Massachusetts, 3 in New York and 2 in New Jersey), 6 of which (2 in Massachusetts, 2 in New York and 1 in New Jersey) were classified as fisheries interactions. In 2013, 10 cases were classified as human interaction, 4 of which were fishery interactions. In 2014, 5 cases were classified as human interaction, 1 of which was a fishery interaction. In an analysis of mortality causes of stranded marine mammals on Cape Cod and southeastern Massachusetts between 2000 and 2006, Bogomolni (2010) reported that 61% of stranded common dolphins were involved in mass-stranding events, and 37% of all the common dolphin stranding mortalities were disease-related.

The Marine Animal Response Society of Nova Scotia reported one common dolphin stranded in 2010 (released alive), 2 (one a fisheries interaction) in 2011, 0 in 2012 and 2013, and 3 in 2014 (Tonya Wimmer, pers. comm.).

Table 3. Common dolphin (*Delphinus delphis delphis*) reported strandings along the U.S. Atlantic coast, 2010-2014.

| STATE | 2010 | 2011 | 2012 | 2013 | 2014 | TOTALS |
|---|---|---|---|---|---|---|
| Maine | 1 | 0 | 2 | 0 | 0 | **3** |
| Massachusetts[a] | 71 | 64 | 221 | 48 | 37 | **441** |
| Rhode Island[c] | 7 | 5 | 6 | 6 | 6 | **30** |
| Connecticut | 1 | 0 | 0 | 0 | 0 | **1** |
| New York [c] | 9 | 17 | 13 | 24 | 7 | **70** |
| New Jersey[a, c] | 14 | 9 | 14 | 19 | 8 | **64** |
| Delaware[c] | 0 | 1 | 1 | 3 | 0 | **5** |
| Maryland | 0 | 1 | 1 | 3 | 0 | **5** |
| Virginia[a,c] | 5 | 9 | 4 | 13 | 9 | **40** |
| North Carolina[a,c] | 6 | 18 | 0 | 9 | 6 | **39** |
| **TOTALS** | **114** | **124** | **262** | **125** | **73** | **698** |

a. Massachusetts mass strandings (2010 - 2,2,3,3,3,4,5,8; 2011-3,3,4,7,13; 2012 - 23 group events ranging from 2 to 22 animals each, 2013 - 4, 3 2, 2014 – 2, 2, 5, 5). North Carolina mass stranding of 4 animals in 2011. Two mass strandings in Virginia in April 2013 - a group of 4 and a group of 2. Three animals (one released alive) involved in mass stranding in NJ in 2012.

b. Seven HI cases in 2010 (4 mortalities in MA, 2 released alive in RI, and 1 mortality in New Jersey), 2 of which (Massachusetts) were classified as fishery interactions. Three HI cases in 2011, all in Massachusetts, 2 of which were classified as fishery interactions (but one of those fishery interaction animals was released alive). Twelve HI cases in 2012 (7 in Massachusetts, 3 in New York and 2 in New Jersey), 6 of which (2 in Massachusetts, 2 in New York and 1 in New Jersey) were classified as fisheries interactions. Ten records with indications of human interactions in 2013 (3 in New York, 1 in Rhode Island and 6 in Massachusetts), 4 of which (1 in Massachusetts and 3 in New York) were classified as fishery interactions. Five records of human interaction in 2014 (1 fisheries interaction in Rhode Island, 2 other human interactions in Massachusetts and 2 in Rhode Island). Two of the human interactions in 2014 (1 Massachusetts and 1 Rhode Island) involved live animals.

Stranding data probably underestimate the extent of fishery-related 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. However a recently published human interaction manual (Barco and Moore 2013) and case criteria for human interaction determinations (Moore *etal.* 2013) should help with this.

## STATUS OF STOCK

Common dolphins are not listed as threatened or endangered under the Endangered Species Act, and the Western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. The 2010–2014 average annual human-related mortality does not exceed PBR. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of common dolphins, relative to

OSP, in the U.S. Atlantic EEZ is unknown. Population trends for this species have not been investigated.

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# COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Western North Atlantic Offshore Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two morphologically and genetically distinct common bottlenose dolphin morphotypes (Duffield *et al.* 1983; Mead and Potter 1995; Rosel *et al.* 2009) described as the coastal and offshore forms in the western North Atlantic (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997; Rosel *et al.* 2009). The two morphotypes are genetically distinct based upon both mitochondrial and nuclear markers (Hoelzel *et al.* 1998; Rosel *et al.* 2009). The offshore form is distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic Ocean from Georges Bank to the Florida Keys (Figure 1; CETAP 1982; Kenney 1990), where dolphins with characteristics of the offshore type have stranded. However, common bottlenose dolphins have occasionally been sighted in Canadian waters, on the Scotian Shelf (e.g., Baird *et al.* 1993; Gowans and Whitehead 1995), and these animals are thought to be of the offshore form.

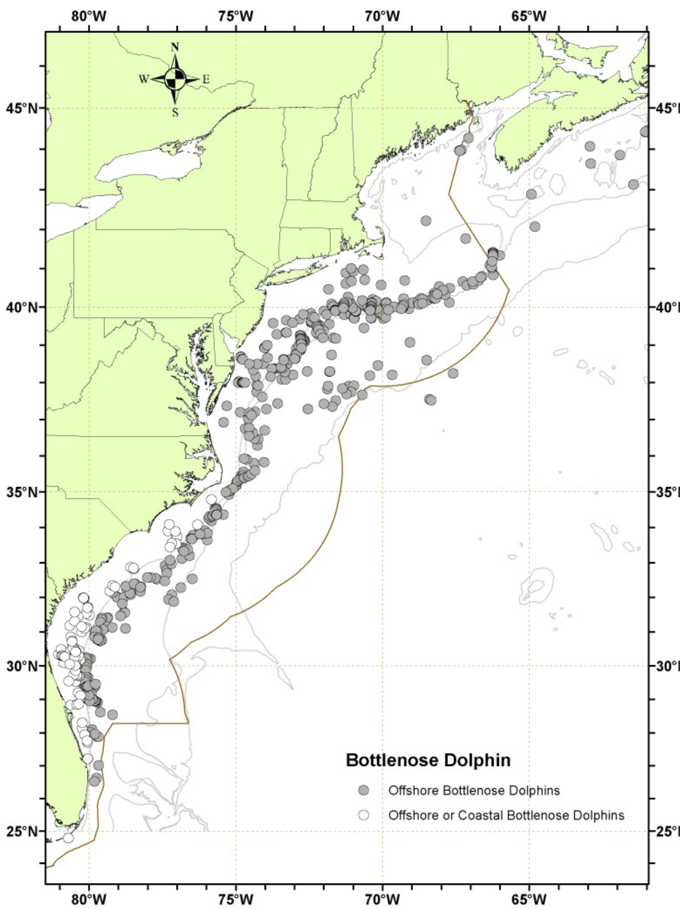


**Figure 1.** *Distribution of bottlenose dolphin sightings from NEFSC and SEFSC aerial surveys during summer in 1998, 1999, 2002, 2004, 2006 and 2011. Isobaths are the100-m, 1,000-m, and 4,000-m depth contours.*

North of Cape Hatteras, there is separation of the two morphotypes across bathymetry during summer months. Aerial surveys flown during 1979–1981 indicated a concentration of common bottlenose dolphins in waters < 25 m deep corresponding to the coastal morphotype, and an area of high abundance along the shelf break corresponding to the offshore stock (CETAP 1982; Kenney 1990). Biopsy tissue sampling and genetic analysis demonstrated that common bottlenose dolphins concentrated close to shore were of the coastal morphotype, while those in waters > 40 m depth were from the offshore morphotype (Garrison *et al.* 2003). However, south of Cape Hatteras, North Carolina, the ranges of the coastal and offshore morphotypes overlap to some degree. Torres *et al.* (2003) found a statistically significant break in the distribution of the morphotypes at 34 km from shore based upon the genetic analysis of tissue samples collected in nearshore and offshore waters from New York to central Florida. The offshore morphotype was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal morphotype. More recently, offshore morphotype animals have been sampled as close as 7.3 km from shore in water depths of 13 m (Garrison *et al.* 2003). Systematic biopsy collection surveys were conducted coast-wide during the summer and winter between 2001 and 2005 to evaluate the degree of spatial overlap between the two morphotypes. Over the continental shelf south of Cape Hatteras, North Carolina, the two morphotypes overlap spatially, and the probability of a sampled group being from the offshore morphotype increased with increasing depth based upon a logistic regression analysis (Garrison *et al.* 2003). Hersh and Duffield (1990) examined common bottlenose dolphins that stranded along the southeast coast of Florida and found four that had hemoglobin profiles matching that of the offshore morphotype. These strandings suggest the offshore form occurs as far south as southern Florida. The range of the offshore common bottlenose dolphin includes waters beyond the continental slope (Kenney 1990), and also waters beyond the U.S. EEZ, and therefore the offshore stock is a transboundary stock (Figure 1). Offshore common bottlenose dolphins may move between the Gulf of Mexico and the Atlantic (Wells *et al.* 1999).

The western North Atlantic Offshore Stock of common bottlenose dolphins is being considered separate from the Gulf of Mexico Oceanic Stock of common bottlenose dolphins for management purposes. One line of evidence to support this decision comes from Baron *et al.* (2008), who found that Gulf of Mexico common bottlenose dolphin whistles (collected from oceanic waters) were significantly different from those in the western North Atlantic Ocean (collected from continental shelf and oceanic waters) in duration, number of inflection points and number of steps.

## POPULATION SIZE

The best available estimate for the offshore stock of common bottlenose dolphins in the western North Atlantic is 77,532 (CV=0.40; Table 1; Palka 2012; Garrison 2016). This estimate is from summer 2011 surveys covering waters from central Florida to the lower Bay of Fundy.

### Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable for the determination of the current PBR.

### Recent surveys and abundance estimates

An abundance estimate of 26,766 (CV=0.52) offshore common bottlenose dolphins was generated from aerial and shipboard surveys conducted during June–August 2011 between central Virginia and the lower Bay of Fundy (Palka 2012). The aerial portion covered 6,850 km of trackline over waters north of New Jersey between the coastline and the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. The shipboard portion covered 3,811 km of trackline between central Virginia and Massachusetts in waters deeper than the 100-m depth contour out to beyond the U.S. EEZ. Both sighting platforms used a double-platform data-collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

An abundance estimate of 50,766 (CV=0.55) offshore common bottlenose dolphins was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida (Garrison 2016). This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed two independent visual teams searching with 25x150 “bigeye” binoculars. A total of 4,445 km of trackline was surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break with generally lower sighting rates over the continental slope. Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Table 1. Summary of recent abundance estimates for western North Atlantic offshore stock of common bottlenose dolphins (*Tursiops truncatus truncatus*) by 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 2011 | central Virginia to lower Bay of Fundy | 26,766 | 0.52 |
| Jun–Aug 2011 | central Florida to central Virginia | 50,766 | 0.55 |
| Jun–Aug 2011 | central Florida to lower Bay of Fundy (COMBINED) | 77,532 | 0.40 |

### 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 abundance estimate is 77,532 (CV=0.40). The minimum population estimate for western North Atlantic offshore common bottlenose dolphin is 56,053.

### Current Population Trend

A trend analysis has not been conducted for this stock. There are 3 abundance estimates from: 1) summer 1998 surveys (29,774; CV=0.25); 2) summer 2002/2004 surveys (81,588; CV=0.17); and 3) summer 2011 surveys (77,532; CV=0.40). Methodological differences between the estimates need to be evaluated before quantifying trends.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations 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 offshore common bottlenose dolphins is 56,053. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor is 0.5 because the 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 western North Atlantic offshore common bottlenose dolphin is therefore 561.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated mean annual fishery-related mortality and serious injury of offshore common bottlenose dolphins during 2010–2014 was 39.4 (CV=0.29; Table 2) due to interactions with the northeast sink gillnet, northeast bottom trawl, mid-Atlantic bottom trawl, and pelagic longline fisheries. The total annual fishery-related mortality and serious injury for this stock during 2010–2014 is unknown because in addition to observed takes, there was a self-reported take in the unobserved mid-Atlantic tuna hook and line fishery during 2010.

### Fisheries Information

The commercial fisheries that interact, or that potentially could interact, with this stock in the Atlantic Ocean are the Category I Atlantic Highly Migratory Species longline; Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline; mid-Atlantic gillnet; and northeast sink gillnet fisheries; the Category II mid-Atlantic bottom trawl and northeast bottom trawl fisheries; and the Category III Gulf of Maine, U.S. mid-Atlantic tuna, shark, swordfish hook and line/harpoon fishery. Detailed fishery information is reported in Appendix III.

### Earlier Interactions

Historically, U.S. fishery interactions have been documented with common bottlenose dolphins in the pelagic drift gillnet fishery, pelagic pair trawl fishery, northeast and mid-Atlantic bottom trawl fisheries, and the northeast and mid-Atlantic gillnet fisheries. See Appendix V for more information on historical takes.

### Longline

The large pelagics longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ, and pelagic swordfish, tunas and billfish are the target species. The estimated annual average mortality and serious injury attributable to the Atlantic Ocean pelagics longline fishery for the 5-year period from 2010 to 2014 was 12.4 common bottlenose dolphins (CV=0.68; Table 2). During 2010–2014, 3 serious injuries to common bottlenose dolphins were observed: 2 during quarter 1 of 2012 in the South Atlantic Bight (SAB) region, and 1 during quarter 3 of 2012 in the Northeast Coastal (NEC) region (Garrison and Stokes 2013; see also Garrison and Stokes 2012a,b; 2014; 2016). During 2010 (1 animal), 2011 (2 animals), 2012 (2 animals), and 2013 (2 animals), a total of 7 common bottlenose dolphins were observed entangled and released alive in the SAB, Mid-Atlantic Bight (MAB) and NEC regions (Garrison and Stokes 2012a,b; 2013; 2014; 2016). These animals were presumed to have no serious injuries.

Historically in the large pelagics longline fishery, no common bottlenose dolphin mortalities or serious injuries were observed between 2002 and 2008 (Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009). However, 1 common bottlenose dolphin serious injury was observed during quarter 4 of 2009 in the MAB region

(Garrison and Stokes 2010), and 1 common bottlenose dolphin was observed entangled and released alive, presumed to have no serious injuries, in 2005 in the SAB region (Fairfield Walsh and Garrison 2006).

The Atlantic Highly Migratory Species longline fishery operates outside the U.S. EEZ. No takes of common bottlenose dolphins within high seas waters of the Atlantic Ocean have been observed or reported thus far.

See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical estimates of annual mortality and serious injury.

Table 2. Summary of the incidental mortality and serious injury of Atlantic Ocean offshore common bottlenose dolphins (*Tursiops truncatus truncatus*) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

| Fishery | Years | Data Type[a] | Observer Coverage[b] | Observed Serious Injury | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Est. CVs | Mean Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Sink Gillnet | 10–14 | Obs. Data Logbook | .17, .19, .15, .11, 0.18 | 0,0,0,0,0 | 0,0,0,1,0 | 0,0,0,0,0 | 0,0,0,26,0 | 0,0,0,26,0 | .00, .00, .00, .95, .00 | 5.2 (0.95) |
| Northeast Bottom Trawl [c] | 10–14 | Obs. Data Logbook | .16, .26, .17, .15, .17 | 0,0,0,0,0 | 1,0,0,0,0 | 0,0,0,0,0 | 4,10,0,0,0 | 4,10,0,0,0 | .53, .84, NA, NA, NA | 2.8 (0.62) |
| Mid-Atlantic Bottom Trawl [c] | 10–14 | Obs. Data Logbook | .06, .08, .05, .06, .08 | 0,0,0,0,0 | 5,2,1,0,3 | 0,0,0,0,0 | 20,34, 16,0,25 | 20,34,16, 0,25 | .34, .31, 1.0, NA, .66 | 19 (0.28) |
| Pelagic Longline | 10–14 | Obs. Data Logbook | .08, .09, . 07, .09, . 10 | 0,0,3,0,0 | 0,0,0,0,0 | 0,0, 61.8,0,0 | 0,0,0,0,0 | 0,0, 61.8,0,0 | NA, NA, .68, NA, NA | 12.4 (0.68) |
| TOTAL | | | | | | | | | | 39.4 (0.29) |

[a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

[b] Proportion of sets observed (for Pelagic Longline).

[c] Fishery related bycatch rates for 2010–2014 were estimated using an annual stratified ratio-estimator following the methodology described in Lyssikatos (2015).

**Northeast Sink Gillnet**

During 2010–2014, 1 mortality was observed (in 2013) in the northeast sink gillnet fishery (Orphanides 2013; Hatch and Orphanides 2014; 2015; 2016). No takes were observed during 2010–2012 and 2014. There were no observed injuries of common bottlenose dolphins in the Northeast region during 2010–2014 to assess using new serious injury criteria. See Table 2 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**

During 2010–2014, 5 mortalities were observed in the northeast bottom trawl fishery (Lyssikatos 2015). There were no observed injuries of common bottlenose dolphins in the northeast region during 2010–2014 to assess using new serious injury criteria. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Through the Marine Mammal Authorization Program (MMAP), there were 2 self-reported incidental takes (mortalities) of common bottlenose dolphins during 2014 off Rhode Island by fishers trawling for *Illex* squid.

**Mid-Atlantic Bottom Trawl**

During 2010–2014, 11 mortalities were observed in the mid-Atlantic bottom trawl fishery (Lyssikatos 2015). There were no observed injuries of common bottlenose dolphins in the mid-Atlantic region during 2010–2014 to assess using new serious injury criteria. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Through the MMAP, there were 2 self-reported incidental takes (mortalities) involving 3 common bottlenose dolphins in total during 2011 off Rhode Island and New Jersey by fishers trawling for *Loligo* squid.

**U.S. Mid-Atlantic Tuna Hook and Line**

Through the MMAP, there was 1 self-reported incidental take (serious-injury) of a common bottlenose dolphin during 2010 off North Carolina by a fisher using hook and line targeting tuna.

**Other Mortality**

Common bottlenose dolphins are among the most frequently stranded small cetaceans along the Atlantic coast. Many of the animals show signs of human interaction (*i.e.*, net marks, mutilation, etc.); however, it is unclear what proportion of these stranded animals is from the offshore stock because most strandings are not identified to morphotype, and when they are, animals of the offshore form are uncommon. For example, only 19 of 185 *Tursiops* strandings in North Carolina were genetically assigned to the offshore form (Byrd *et al.* 2014).

An Unusual Mortality Event (UME) of bottlenose dolphins and other cetaceans occurred along the mid-Atlantic coast from New York to Brevard County, Florida, from 1 July 2013 to 1 March 2015. The total number of stranded bottlenose dolphins was ~1650. Morbillivirus has been determined to be a primary cause of the event. Post-UME monitoring of bottlenose dolphins will continue over the next few years, and work continues to determine the effect of this event on bottlenose dolphin stocks in the Atlantic.

## STATUS OF STOCK

The common bottlenose dolphin in the western North Atlantic is not listed as threatened or endangered under the Endangered Species Act, and the offshore stock is not considered strategic under the MMPA. Total U.S. fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching the zero mortality and serious injury rate. The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this stock.

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

## STOCK DEFINITION AND GEOGRAPHIC RANGE

This stock is found in U.S. and Canadian Atlantic waters. The distribution of harbor porpoises has been documented by sighting surveys, 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 and southern Bay of Fundy region, generally in waters less than 150 m deep (Gaskin 1977; Kraus *et al.* 1983; Palka 1995), with a few sightings in the upper Bay of Fundy and on Georges Bank (Palka 2000). During fall (October–December) and spring (April–June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. They are seen from the coastline to deep waters (>1800 m; Westgate *et al.* 1998), although the majority of the population is found over the continental shelf. 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. There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region. However, during the fall, several satellite-tagged harbor porpoises did favor 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).

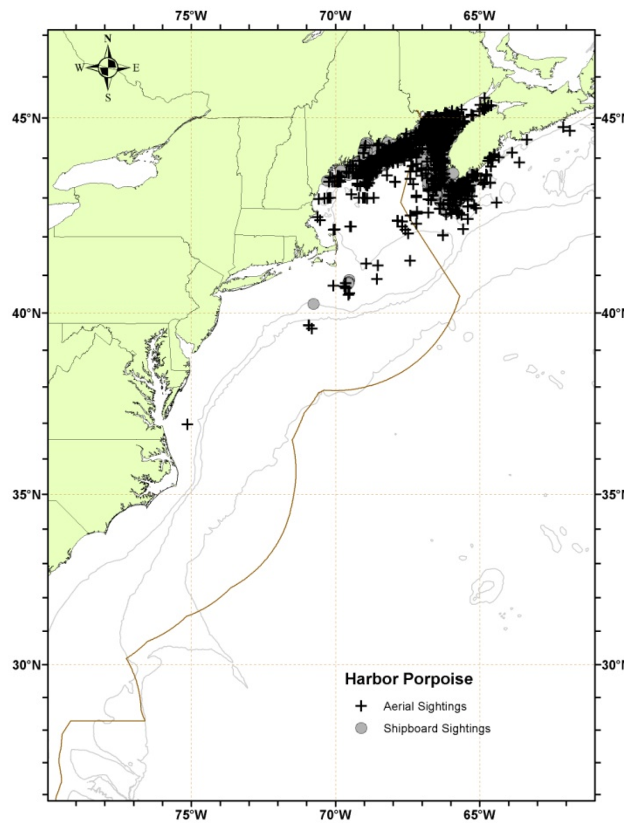


**Figure 1**. *Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011 and DFO's 2007 TNASS survey. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

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.

## POPULATION SIZE

The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is from the 2011 survey: 79,883 (CV=0.32).

### Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for the determination of the current PBR.

### Recent surveys and abundance estimates

An abundance estimate of 79,883 (CV=0.32) harbor porpoises was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of central Virginia to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a double-platform team data-collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

No harbor porpoises were detected in an abundance survey that was conducted concurrently (June-August 2011) in waters between central Virginia and central Florida. This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed the double-platform methodology searching with 25x150 "bigeye" binoculars. A total of 4,445 km of tracklines was surveyed, yielding 290 cetacean sightings.

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 ($N_{best}$) and coefficient of variation (CV).

| Month/Year | Area | $N_{best}$ | CV |
|---|---|---|---|
| Jul-Aug 2011 | Central Virginia to lower Bay of Fundy | 79,883 | 0.32 |

### 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 harbor porpoises is 79,883 (CV=0.32). The minimum population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 61,415.

### 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.

## 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 61,415. The maximum productivity rate is 0.046. The recovery factor is 0.5 because stock's status relative to 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 is 706.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual estimated average human-caused mortality is 437 harbor porpoises per year. This is derived from two components: 394 harbor porpoise per year (CV=0.18) from U.S. fisheries using observer and MMAP data, and 43 per year (unknown CV) from Canadian fisheries using observer data.

### Fishery Information

Recently, Gulf of Maine/Bay of Fundy harbor porpoise takes have been documented in the U.S. northeast sink gillnet, mid-Atlantic gillnet, and northeast bottom trawl fisheries and in the Canadian herring weir fisheries (Table 2). Detailed U.S. fishery information is reported in Appendix III.

### Earlier Interactions

One harbor porpoise was observed taken in the Atlantic pelagic drift gillnet fishery during 1991–1998; the fishery ended in 1998. This observed bycatch was notable because it occurred in continental shelf edge waters adjacent to Cape Hatteras (Read *et al.* 1996). See Appendix V for more information on historical takes.

### U.S.

### Northeast Sink Gillnet

Harbor porpoise bycatch in the northern Gulf of Maine occurs primarily from June to September, while in the southern Gulf of Maine, 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 2013; Hatch and Orphanides 2014, 2015, 2016). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

There appeared to be no evidence of differential mortality in U.S. or Canadian gillnet fisheries by age or sex in animals collected before 1994, although there was substantial inter-annual variation in the age and sex composition of the bycatch (Read and Hohn 1995). Using observer data collected during 1990–1998 and a logit regression model, females were 11 times more likely to be caught in the offshore southern Gulf of Maine region, males were more likely to be caught in the south Cape Cod region, and the overall proportion of males and females caught in a gillnet and brought back to land were not significantly different from 1:1 (Lamb 2000).

Scientific experiments that demonstrated the effectiveness of pingers in the Gulf of Maine were conducted during 1992 and 1993 (Kraus *et al.* 1997). After the scientific experiments, experimental fisheries were allowed in the general fishery during 1994 to 1997 in various parts of the Gulf of Maine and south of Cape Cod areas. During these experimental fisheries, bycatch rates of harbor porpoises in pingered nets were less than in non-pingered nets.

A study on the effects of two different hanging ratios in the bottom-set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010 with 100% observer coverage which took place in both the Northeast and mid-Atlantic gillnet fisheries. Commercial fishing vessels from Massachusetts and New Jersey were used for the study, which took place south of the Harbor Porpoise Take Reduction Cape Cod South Management Area (south of 40° 40´N) in February–April. Researchers purposely picked an area of historically high bycatch rates in order to have a chance of finding a significant difference. Eight research strings of fourteen nets each were fished and 159 hauls were completed during the course of the 2009–2010 study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh, there was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios. Twelve harbor porpoises were caught in this project in 79 hauls during 2009 and one animal was caught in 72 hauls during the 2010 experiment in the Northeast (A.I.S., Inc. 2010). The 2010 animal was included in the observed interactions and added into the total estimates (Table 2), though these animals and the fishing effort from this experiment were not included in the estimation of the bycatch rate that was expanded to the rest of the fishing effort. The 2009 takes were included in earlier editions of this report.

**Mid-Atlantic Gillnet**

Annual bycatch is estimated using ratio estimator techniques (Orphanides 2013; Hatch and Orphanides 2014, 2015, 2016). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

In the northeast gillnet fishery section above, see the description of the study on the effects of two different hanging rations in the bottom-set gillnet fishery which took place in both the northeast and mid-Atlantic gillnet fisheries. Ten harbor porpoises were caught in 8 hauls in the mid-Atlantic in 2010 as part of this experiment (A.I.S., Inc. 2010). Harbor porpoises that were caught in this study were included in the observed interactions and added into the total estimates (Table 2), though these animals and the fishing effort from this experiment were not included in the estimation of the bycatch rate that was expanded to the rest of the fishing effort.

**Northeast Bottom Trawl**

Since 1989, harbor porpoise mortalities have been observed in the northeast bottom trawl fishery, but many of these were not attributable to this fishery because decomposed animals are presumed to have been dead prior to being taken by the trawl. New serious injury criteria were applied to all observed interactions retroactive back to 2007 (Waring *et al*. 2014, 2015, Wenzel *et al*. 2015, 2016). Fishery-related bycatch rates for years since 2008 were estimated using an annual stratified ratio-estimator (Lyssikatos 2015). These estimates replace the 2008–2010 annual estimates reported in the 2013 stock assessment report that were generated using a different method. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information

**CANADA**

**Bay of Fundy Sink Gillnet**

The earlier estimated annual mortality estimates were 38 for 1998, 32 for 1999, 28 for 2000, and 73 for 2001 (Trippel and Shepherd 2004). Estimates of variance are not available. However, since 2002 there has been no observer program in the Bay of Fundy region, but the fishery is still active. Bycatch for these years is unknown. The annual average of the most recent five years with available data (1997–2001) was 43 animals, so this value is used to estimate the annual average for more recent years. In 2011 there was little gillnet effort in New Brunswick waters in the summer; thus the Canadian porpoise by-catch estimates could have been near zero. The fishermen that sought groundfish went into the mid-Bay of Fundy where traditionally bycatch levels were extremely low, though current bycatch levels are unknown. Trippel (pers. comm.) estimated that fewer than 10 porpoises were bycaught in the Canadian fisheries in the Bay of Fundy in 2011. Analysis of port catch records might allow estimation of bycatch for more recent times, however, it would be difficult to also accurately account for the changes in the spatial distribution of the harbor porpoises and fisheries.

**Herring Weirs**

Harbor porpoises are taken in Canadian herring weirs, but there have been no recent efforts to observe takes in the U.S. component of this fishery. Smith *et al.* (1983) estimated that in the 1980s approximately 70 harbor porpoises became trapped annually and, on average, 27 died annually. In 1990, at least 43 harbor porpoises were trapped in Bay of Fundy weirs (Read *et al.* 1994). In 1993, after a cooperative program between fishermen and Canadian biologists was initiated, over 100 harbor porpoises were released alive (Read *et al.* 1994). Between 1992 and 1994, this cooperative program resulted in the live release of 206 of 263 harbor porpoises caught in herring weirs. Mortalities (and releases) were 11 (50) in 1992, 33 (113) in 1993, and 13 (43) in 1994 (Neimanis *et al.* 1995). Since that time, additional harbor porpoises have been documented in Canadian herring weirs: mortalities (releases and unknowns) were 5 (60, 0) in 1995, 2 (4, 0) in 1996, 2 (24, 0) in 1997, 2 (26, 0) in 1998, 3 (89, 0) in 1999, 0 (13, 0) in 2000 (A. Read, pers. comm), 14 (296, 0) in 2001, 3 (46, 4) in 2002, 1 (26, 3) in 2003, 4 (53, 2) in 2004, 0 (19, 5) in 2005, 2 (14, 0) in 2006, 3 (9, 3) in 2007, 0 (8, 6) in 2008, 0 (3,4) in 2009, 1 in 2010 (7, 0), 0 (2, 3) in 2011, 0 (2, 3) in 2012, 0 (2,0) in 2013 and 0 (9, 2) in 2014 (Neimanis *et al.* 2004; H. Koopman and A. Westgate, pers. comm.).

See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information

Table 2. From observer program data, summary of the incidental mortality of Gulf of Maine/Bay of Fundy harbor porpoise (*Phocoena phocoena phocoena*) by 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 (CV in parentheses).

| Fishery | Years | Data Type [a] | Observer Coverage [b] | Observed Serious Injury[i] | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Combined Serious Injury | Estimated CVs | Mean Annual Combined Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| U.S. | | | | | | | | | | |
| Northeast Sink Gillnet [c, h] | 10-14 | Obs. Data, Weighout, Trip Logbook | .17, .19, .15, .11, .18 | 0, 0, 0, 0, 0 | 50, 66, 34, 20, 28 | 0, 0, 0, 0, 0 | 387, 273, 277, 399, 128 | 387, 273, 277, 399, 128 | .27, .20, .59, .33, .27 | 293 (0.17) |
| Mid-Atlantic Gillnet [h] | 10-14 | Obs. Data Weighout | .04, .02, .02, .03, .05 | 0, 0, 0, 0, 0 | 18, 11, 2, 1, 1 | 0, 0, 0, 0, 0 | 259, 123, 63, 19, 22 | 259, 123, 63, 19, 22 | .88, .41, .83, 1.06, 1.03 | 97 (0.5) |
| Northeast bottom trawl [g] | 10-14 | Obs. Data Weighout | .16, .26, .17, .15, .17 | 0, 1, 0, 0, 0 | 0, 1, 0, 1, 1 | 0, 2, 0, 0, 0 | 0, 3.9, 0, 7, 5.5 | 0, 5.9, 0, 7, 5.5 | 0, .71, 0, .98, .86 | 3.7 (0.51)[g] |
| U.S. TOTAL | 2010-2014 | | | | | | | | | 394 (0.18) |
| CANADA | | | | | | | | | | |
| Bay of Fundy Sink Gillnet [f] | 1997-2001 | Can. Trips | unk | | 19, 5, 3, 5, 39 | | 43, 38, 32, 28, 73 | | unk | 43 [f] (unk) |
| Herring Weir [d,e] | 10-14 | Coop. Data | unk | | 1, 0, 0, 0, 0 | | 1, 0, 0, 0, 0 | | NA | 0.2 (unk) |
| CANADIAN TOTAL | 2010-2014 | | | | | | | | | 43 (unk) |
| GRAND TOTAL | | | | | | | | | | 437 (unk) |

NA = Not available.

a. Observer data (Obs. Data) are used to measure bycatch rates; the U.S. data are collected by the Northeast

Fisheries Science Center (NEFSC) Sea Sampling Program and At-Sea Monitoring Program; the Canadian data are collected by DFO. NEFSC collects Weighout (Weighout) landings data that are used as a measure of total effort for the U.S. gillnet fisheries. The Canadian DFO catch and effort statistical system collected the total number of trips fished by the Canadians (Can. Trips), which was the measure of total effort for the Canadian groundfish gillnet fishery. Mandatory vessel trip report (VTR) (Trip Logbook) data are used to determine the spatial distribution of fishing effort in the northeast sink gillnet fishery. Observed mortalities from herring weirs are collected by a cooperative program between fishermen and Canadian biologists (Coop. Data).

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. Total observer coverage reported for bottom trawl gear and gillnet gear in the year 2010 includes only samples collected from traditional fisheries observer, but not the fishery monitors. Monitor trips were incorporated starting in 2011, the first full year of monitor coverage.

c. Since 2002 in the Northeast gillnet fishery, harbor porpoises were taken on pingered strings within strata that required pingers but that stratum also had observed strings without pingers. For estimates made during 1998 and after, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within a stratum. The weighted bycatch rate was:

$$\sum_{i}^{ping,non-ping} \frac{\#\,porpoise_i}{sslandings_i} \cdot \frac{\#\,hauls_i}{total\#\,hauls}$$

There were 10, 33, 44, 0, 11, 0, 2, 8, 6, 2, 26, 2, 4, 12, 2, 9, 6, 11, 23, 11, 30, 20, and 27 observed harbor porpoise takes on pinger trips from 1992 to 2014, respectively, that were included in the observed mortality column.

d. There were 255 licenses for herring weirs in the Canadian Bay of Fundy region.

e. Data provided by H. Koopman pers. comm.

f. The Canadian gillnet fishery was not observed during 2002 and afterwards, but the fishery is still active; thus, the current bycatch estimate for this fishery is assumed to be the average estimate using last five years that the fishery was observed in (1997–-2001).

g. Fishery related bycatch rates for years 2010–2014 were estimated using an annual stratified ratio-estimator.

h. One harbor porpoise in the Northeast area and 10 in the mid-Atlantic area were incidentally caught in 2010 as part of a 2009-2010 NEFSC gillnet hanging ratio study to examine the impact of hanging ratio on harbor porpoise bycatch in gillnets. These animals were included in the observed interactions and added to the total estimates, though these interactions and their associated fishing effort were not included in the estimation of the bycatch rate that was expanded to the rest of the fishery.

i. Serious injuries were evaluated for the 2010–2014 period using new guidelines and include both at-sea monitor and traditional observer data (Waring *et al.* 2014, 2015, Wenzel *et al*. 2015, 2016)

**Other Mortality**

**U.S.**

There is evidence that harbor porpoises were harvested by natives in Maine and Canada before the 1960s, and the meat was used for human consumption, oil, and fish bait (NMFS 1992). The extent of these past harvests is unknown, though it is believed to have been small. Up until the early 1980s, small kills by native hunters (Passamaquoddy Indians) were reported. In recent years it was believed to have nearly stopped (Polacheck 1989) until media reports in September 1997 depicted a Passamaquoddy tribe member dressing out a harbor porpoise. Further articles describing use of porpoise products for food and other purposes were timed to coincide with ongoing legal action in state court.

During 2010, 82 harbor porpoises were reported stranded on Atlantic U.S. beaches. Of these, six stranding mortalities were reported as having signs of human interaction, three of which were reported to be fishery interactions.

During 2011, 164 harbor porpoises were reported stranded on Atlantic U.S. beaches. Of these, nine stranding mortalities were reported as having signs of human interaction, three of which were reported to be fishery interactions.

During 2012, 45 harbor porpoises were reported stranded on Atlantic U.S. beaches. Of these, four stranding mortalities were reported as having signs of human interaction, one of which was reported to be a fishery interaction.

During 2013, 102 harbor porpoises were reported stranded on Atlantic U.S. beaches. Of these, nine stranding mortalities were reported as having signs of human interaction, three of which were reported to be fishery interactions.

During 2014, 39 harbor porpoises were reported stranded on Atlantic U.S. beaches. Of these, one stranding mortality was reported as having signs of human interactions, which was also reported to have been a fishery interaction.

Stranding data probably underestimate the extent of fishery-related 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 4. Harbor Porpoise (*Phocoena phocoena phocoena*) reported strandings along the U.S. and Canadian Atlantic coast, 2010-2014.

| Area | Year | | | | | **Total** |
|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 | |
| Maine[a,e,h] | 7 | 15 | 7 | 7 | 5 | **41** |
| New Hampshire | 5 | 1 | 3 | 1 | 0 | **10** |
| Massachusetts[a, e,f, g, h] | 28 | 102 | 25 | 40 | 16 | **211** |
| Rhode Island[b,f] | 0 | 4 | 0 | 3 | 0 | **7** |
| Connecticut[h] | 0 | 0 | 0 | 1 | 0 | **1** |
| New York[c,f, h] | 1 | 11 | 3 | 15 | 0 | **30** |
| New Jersey[e, h] | 7 | 1 | 2 | 8 | 4 | **22** |
| Pennsylvania | 0 | 0 | 0 | 0 | 0 | **0** |
| Delaware | 2 | 0 | 0 | 2 | 0 | **4** |
| Maryland | 4 | 0 | 1 | 3 | 0 | **8** |
| Virginia[d],[e,f] | 10 | 2 | 2 | 15 | 3 | **32** |
| North Carolina[e] | 18 | 28 | 2 | 7 | 11 | **66** |
| **TOTAL U.S.** | **82** | **164** | **45** | **102** | **39** | **432** |
| Nova Scotia/Prince Edward Island[i] | 5 | 13 | 6 | 21 | 9 | **54** |
| Newfoundland and New Brunswick[j] | 1 | 0 | 0 | 3 | 0 | **4** |
| **GRAND TOTAL** | **88** | **177** | **51** | **126** | **48** | **490** |

a. In Massachusetts in 2011, 5 animals were released alive and one taken to rehab. One Maine animal was taken to rehab in 2012. Three Massachusetts live strandings were taken to rehab in 2013 and 1 Maine animal was released alive.

b. In Rhode Island in 2011, one animal classified as human interaction due to fluke amputation.

c. One of the 2012 New York strandings classified as human interaction due to interaction with marine debris.

d. In 2014, one harbor porpoise in Virginia was classified as a fishery interaction.

e. Six total HI cases in 2010; 2 in Massachusetts, 1 in Maine, 1 in North Carolina and 2 in New Jersey. One of the New Jersey records, one of the North Carolina records, and the Maine record were fishery interactions.

f. Nine total HI cases in 2011; 5 in Massachusetts, 1 in Rhode Island, 2 in New York and 1 in Virginia. Two of these Massachusetts animals and the Virginia animal were fishery interactions.

g. Four HI cases in 2012. One of these was a fishery interaction (Massachusetts).
h. Ten total HI cases in 2013 (MA-3, ME-2, NY-3, NJ-1, CT-1), including one released alive (ME). Three of these were considered fishery interactions, including one entangled in gear in Maine.
i. Data supplied by Nova Scotia Marine Animal Response Society (pers. comm.). One of the 2012 animals trapped in mackerel net. Not included in count for 2014 are at least 8 animals released alive from weirs.
j. (Ledwell and Huntington 2010, 2011, 2012a, 2012b, 2013, 2014).

**CANADA**

Whales and dolphins stranded on the coast of Nova Scotia are recorded by the Marine Animal Response Society and the Nova Scotia Stranding Network, including 5 (1 released alive) in 2010, 13 (4 released alive) in 2011, 6 in 2012, 21 in 2013 and 9 in 2014; Table 3).

One dead stranded harbor porpoise was reported in 2010 by the Newfoundland and Labrador Whale Release and Strandings Program, 0 in 2011 and 2012, 3 in 2013, and 0 in 2014 (Ledwell and Huntington 2010, 2011, 2012a, 2012b, 2013; 2014; Table 3).

**STATUS OF STOCK**

Harbor porpoise in the Gulf of Maine/Bay of Fundy are not listed as threatened or endangered under the Endangered Species Act, and this stock is not considered strategic under the MMPA. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of harbor porpoises, relative to OSP, in the U.S. Atlantic EEZ is unknown. Population trends for this species have not been investigated.

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# HARBOR SEAL (*Phoca vitulina vitulina*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal (*Phoca vitulina*) is found in all nearshore waters of the North Atlantic and North Pacific Oceans and adjoining seas above about 30ºN (Burns 2009; Desportes *et al*. 2010). In the western North Atlantic, they are distributed from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Mansfield 1967; Boulva and McLaren 1979; Katona *et al.* 1993;; Baird 2001;Desportes *et al*. 2010). Although the stock structure of the western North Atlantic subspecies (*P. v.* concolor) is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population (Temte *et al.* 1991; Andersen and Olsen 2010). In U.S. waters, breeding and pupping normally occur in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte *et al.* 1991; Katona *et al.* 1993).

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona *et al*. 1993), and occur seasonally along the southern New England to New Jersey coasts from September through late May (Schneider and Payne 1983; Schroeder 2000;). Scattered sightings and strandings have been recorded as far south as Florida (NOAA National Marine Mammal Health and Stranding Response Database, accessed 08 October 2015). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Rosenfeld *et al.* 1988; Whitman and Payne 1990; Jacobs and Terhune 2000). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine Coast (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Waring *et al*. 2006). Earlier research identified no pupping areas in southern New England (Payne and Schneider 1984); however, more recent anecdotal reports suggest that some pupping is occurring at high-use haulout sites off Manomet, Massachusetts and the Isles of Shoals, Maine.

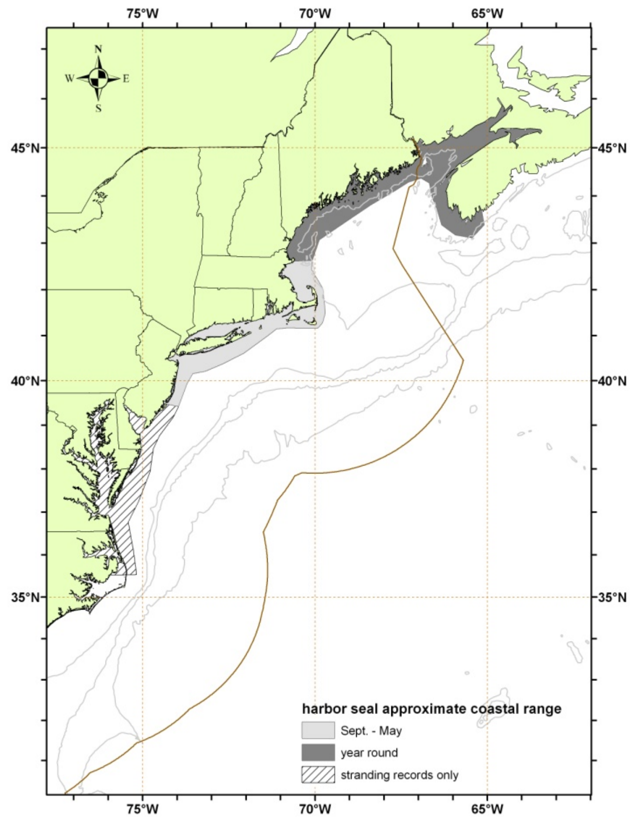


**Figure 1**. *Approximate coastal range of harbor seals, and distribution of harbor seal sightings at sea from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

Prior to the spring 2001 live-capture and radio-tagging of adult harbor seals (Waring *et al.* 2006), it was believed that the majority of seals moving into southern New England and mid-Atlantic waters were subadults and juveniles (Whitman and Payne 1990; Katona *et al.* 1993). The 2001 study established that adult animals also made this migration. Seventy-five percent (9/12) of the seals tagged in March in Chatham Harbor were detected at least once during the May/June 2001 abundance survey along the Maine coast (Gilbert *et al.* 2005; Waring *et al.* 2006). Similar findings were made in spring 2011 and 2012 work (Waring *et al.* 2015a).

## POPULATION SIZE

The best current abundance estimate of harbor seals is 75,834 (CV=0.15) which is from a 2012 survey (Waring *et. al.* 2015).

### Earlier abundance estimates

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for determination of the current PBR.

### Recent surveys and abundance estimates

The 2001 survey (Gilbert *et al*. 2005), conducted in May/June, included replicate surveys and radio-tagged seals to obtain a correction factor for animals not hauled out. The 2012 survey was designed (Waring *et al*. 2015a) to sample bay units using a single aircraft, and it also included a radio-tracking aircraft and obtained a correction factor. The corrected estimates (pups in parenthesis) for 2001 and 2012, respectively, were 99,340 (23,722) and 75,834 (23,830) (Table 1). The 2001 observed count of 38,014 was 28.7% greater than the 1997 count, whereas the 2012 corrected estimate was 24% lower than the 2001 estimate. In addition, the CV of the 2012 estimate is 0.153 compared to 0.091in 2001.

Although the 2012 population estimate was lower than the 2001 estimate, Waring *et al.* (2015a) did not consider the population to be declining because the two estimates are not significantly different and because the actual estimate was lower is because some fraction of the population was not in the survey area. Evidence for this is that the 31.4% of the count were pups, a percentage that is biologically unlikely. The estimated number of harbor seal pups did not differ significantly between 2001 and 2012. In 2001, there were an estimated 23,722 (CV=0.096) pups in the study area (Gilbert *et al.* 2005); in 2012 there were an estimated 23,830 (CV=0.159) pups in the study area. Therefore it is likely that there were some non-pups in the population that were not available to be counted because it was not in the study area of Coastal Maine. Some number of seals could have remained farther south in New England, more northerly in Canada, or offshore. Currently there is some uncertainty in the patterns of harbor seal abundance and distribution in the northeastern U.S. Johnston *et al.* (2015) document a decline in stranding and bycatch rates of harbor seals, providing support for an apparent decline in abundance. However, much of the data examined centered in southern New England and did not cover the center of the population in Maine. There has been very little systematic research conducted on fine-scale changes in habitat use, particularly in relation to the sympatric population of gray seals, although Russell *et al.* (2015) found little impact of the presence of gray seals on harbor seal time budgets.

Table 1. Summary of recent abundance estimates for the western North Atlantic harbor seal (*Phoca vitulina concolor*) by 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 |
|---|---|---|---|
| May/June 2012 | Maine coast | 75,834 | 0.15 |

### 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 20$^{th}$ percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for harbor seals is 75,834 (CV=0.15). The minimum population estimate is 66,884 based on corrected available counts along the Maine coast in 2012.

### 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

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% 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 is 66,884 animals. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor ($F_R$) is 0.5, the default value for stocks of unknown status relative to optimum sustainable population (OSP), and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of harbor seals is 2,006.

## ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2010-2014 the total human caused mortality and serious injury to harbor seals is estimated to be 389 per year. The average was derived from three components: 1) 377 (CV=0.13; Table 2) from 2010-2014 observed fisheries; 2) 12 from average 2010-2014 non-fishery-related, human interaction stranding and direct interaction mortalities (NOAA National Marine Mammal Health and Stranding Response Database, accessed 08 October 2015); and 3) 0.2 from U.S. research mortalities. Analysis of bycatch rates from fisheries observer program records likely underestimates lethal (Lyle and Willcox 2008), and greatly under-represents sub-lethal, fishery interactions.

### Fishery Information

Detailed fishery information is given in Appendix III.

### U.S.

### Northeast Sink Gillnet:

Harbor seal bycatch is observed year round where they are most frequently observed in the summer in groundfish trips occurring between Boston, MA and Maine in the coastal Gulf of Maine waters. Williams (1999) aged 261 harbor seals caught in this fishery from 1991 to 1997, and 93% were juveniles (i.e., less than four years old). Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Revised serious injury guidelines were applied for this period (Waring *et al.* 2014, 2015; Wenzel *et al.* 2015, 2016). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information. Analysis methodology and results can be found in Hatch and Orphanides (2014, 2015, 2016).

### Mid-Atlantic Gillnet

Harbor seal bycatch has been observed in this fishery in waters off Massachusetts and New Jersey and rarely further south. A study on the effects of two different hanging ratios in the bottom-set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010 with 100% observer coverage. Commercial fishing vessels from Massachusetts and New Jersey were used for the study, which took place south of the Harbor Porpoise Take Reduction Team Cape Cod South Management Area (south of 40° 40′) in February, March and April. Eight research strings of fourteen nets each were fished, and 159 hauls were completed during the course of the study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh. There was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios. Four harbor seals (3 in mid-Atlantic gillnet and 1 in NE gillnet) were caught in this project during 2010 (AIS 2010).

See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information. Analysis methodology and results can be found in Hatch and Orphanides (2014, 2015, 2016).

### Northeast Bottom Trawl

Harbor seals are occasionally observed taken in this fishery. See Table 2 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

Harbor seals are rarely observed taken in this fishery. Annual harbor seal mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos 2015). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

**Northeast Mid-water Trawl Fishery (Including Pair Trawl)**

Harbor seals are occasionally observed taken in this fishery. An extended bycatch rate has not been calculated for the current 5-year period. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2010–2014 is calculated as 0.8 animal (4 animals /5 years). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

**Mid-Atlantic Mid-water Trawl Fishery (Including Pair Trawl)**

A harbor seal mortality was observed in this fishery in 2010. An expanded bycatch estimate has not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2010–2014 is calculated as 0.2 animals (1 animal/5 years). See Table 2 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**

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003. No mortalities have been observed, but 3 harbor seals were captured and released alive in 2011, 1 in 2012, 1 in 2013 and 0 in 2014. In addition, 8 seals of unknown species were captured and released alive in 2011, and 0 in 2012–2014. One harbor seal and two unknown species in were designated as serious injuries/mortalities in 2011, based on fisheries monitoring logs (Waring *et al*. 2014). An expanded bycatch estimate has not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2010-2014 is calculated as 0.2 animals (1 animal/5 years). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

**CANADA**

Currently, scant data are available on bycatch in Atlantic Canada fisheries due to limited observer programs (Baird 2001). An unknown number of harbor seals have been taken in Newfoundland, Labrador, Gulf of St. Lawrence and Bay of Fundy groundfish gillnets; Atlantic Canada and Greenland salmon gillnets; Atlantic Canada cod traps; and in Bay of Fundy herring weirs (Read 1994; Cairns *et al.* 2000). Furthermore, some of these mortalities (e.g., seals trapped in herring weirs) are the result of direct shooting under nuisance permits.

Table 2. Summary of the incidental mortality of harbor seals (*Phoca vitulina vitulina*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities 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[e] | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Estimated CVs | Mean Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Sink Gillnet[c] | 10–14 | Obs. Data, Weighout, Logbooks | .17, .19, .15, .11, .18 | 0, 0, 0, 0, 0 | 71, 91, 37, 22, 59 | 0, 0, 0, 0, 0 | 540, 343, 252, 142, 390 | 540, 343, 252, 142, 390 | .25, .19, .26, .31, .39 | 334 (0.14) |
| Mid-Atlantic Gillnet | 10–14 | Obs. Data, Weighout | .04, .02, .02, .03, .05 | 0, 0, 0, 0, 0 | 2, 9, 2, 0, 1 | 0, 0, 0, 0, 0 | 89, 21, 0, 0, 19 | 89, 21, 0, 0, 19 | .39, .67, 0, 0, 1.06 | 26 (0.33) |
| Northeast Bottom Trawl | 10–14 | Obs. Data, Weighout | .16, .26, .17, .15, .17 | 0, 0, 0, 0, 0 | 0, 3, 1, 1, 2 | 0, 0, 0, 0, 0 | 0, 9, 3, 4, 11 | 0, 9, 3, 4, 11 | 0, .58, 1, .96, .63 | 4 (.44) |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Mid-Atlantic Bottom Trawl | 10–14 | Obs. Data Dealer | .06, .08, .05, .06, .08 | 0, 0, 0, 0, 0 | 1 ,1, 0, 3, 1 | 0, 0, 0, 0, 0 | 11, 0, 23, 11, 10 | 11, 0, 23, 11, 10 | 1.1, 0, 1, .96, .95 | 11 (.62) |
| Northeast Mid-water Trawl - Including Pair Trawl[d] | 10–14 | Obs. Data Weighout Trip Logbook | .53, .41, .45, .37, .42 | 0, 0, 0, 0, 0 | 2, 0, 1, 0, 1 | 0, 0, 0, 0, 0 | na, 0, na, 0, na | na, 0, na, 0, na | na, 0, na, 0, na | 0.8 (na)[d] |
| Mid-Atlantic Mid-water Trawl - Including Pair Trawl[d] | 10–14 | Obs. Data Weighout Trip Logbook | .25, .41, .21, .07, .05 | 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] |
| Herring Purse Seine | 10–14 | Obs. Data | .12 .33, .17, .17, .08 | 0, 1, 0, 0, 0 | 0, 0, 0, 0, 0 | 0, na, 0, 0, 0 | 0, 0, 0, 0, 0 | 0, na, 0, 0, 0 | 0, na, 0, 0, 0 | 0.2 (na) |
| TOTAL | | | | | | | | | | 377 (0.13) |

[a]Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. NEFSC 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 sink gillnet fishery.

[b]The observer coverages for the northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed and coverages for the bottom and mid-water trawl fisheries are ratios based on trips. Total observer coverage reported for bottom trawl gear and gillnet gear in the years 2010-2014 includes samples collected from traditional fisheries observers in addition to fishery monitors through the Northeast Fisheries Observer Program (NEFOP).

[c]Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2010 - 2014, respectively, 23, 32, 12, 11, and 33 takes were observed in nets with pingers. In 2010 – 2014, respectively, 48, 59, 25, 11, and 26 takes were observed in nets without known pingers.

[d.]Analyses of bycatch mortality attributed to the mid-water trawl fisheries for 2010 – 2014 have not been generated.

[e.] Serious injuries were evaluated for the 2010–2014 period using new guidelines and include both at-sea monitor and traditional observer data (Waring *et al.* 2014, 2015; Wenzel *et al.* 2015, 2016.)

**Other Mortality**

**U.S.**

Historically, harbor seals were bounty-hunted in New England waters, which may have caused a severe decline of this stock in U.S. waters (Katona *et al*. 1993; Lelli *et al*. 2009). Bounty-hunting ended in the mid-1960s.

Other sources of harbor seal mortality include human interactions, storms, abandonment by the mother, disease (Anthony *et al.* 2012), and predation (Katona *et al.* 1993; NOAA National Marine Mammal Health and Stranding Response Database, accessed 08 October 2015; Jacobs and Terhune 2000). Mortalities caused by human interactions include research mortalities, boat strikes, fishing gear interactions, oil spill/exposure, harassment, and shooting.

Harbor seals strand each year throughout their migratory range. Stranding data provide insight into some of these sources of mortality. From 2010 to 2014, 1,368 harbor seal stranding mortalities were reported between Maine and Florida (Table 3; NOAA National Marine Mammal Health and Stranding Response Database, accessed 08 October 2015). Seventy-five (5.4%) of the dead harbor seals stranded during this five-year period showed signs of human interaction (20 in 2010, 20 in 2011, 9 in 2012, 15 in 2013, and 11 in 2014), with 15 (1.0%) having some sign of fishery interaction (6 in 2010, 2 in 2011, 2 in 2012, 3 in 2013, and 2 in 2014). Five harbor seals during this period were reported as having been shot.

An Unusual Mortality Event (UME) was declared for harbor seals in northern Gulf of Maine waters in 2003 and continued into 2004. No consistent cause of death could be determined. The UME was declared over in spring 2005 (MMC 2006). NMFS declared another UME in the Gulf of Maine in autumn 2006 based on infectious disease. A UME was declared in November of 2011 that involved 567 harbor seal stranding mortalities between June 2011 and October 2012 in Maine, New Hampshire, and Massachusetts. The UME was declared closed in February 2013.

Stobo and Lucas (2000) have documented shark predation as an important source of natural mortality at Sable Island, Nova Scotia. They suggest that shark-inflicted mortality in pups, as a proportion of total production, was less than 10% in 1980-1993, approximately 25% in 1994–1995, and increased to 45% in 1996. Also, shark predation on adults was selective towards mature females. The decline in the Sable Island population appears to result from a combination of shark-inflicted mortality on both pups and adult females and inter-specific competition with the much more abundant gray seal for food resources (Stobo and Lucas 2000; Bowen *et al.* 2003).

**CANADA**

Aquaculture operations in eastern Canada are licensed to shoot nuisance seals, but the number of seals killed is unknown (Jacobs and Terhune 2000; Baird 2001). Small numbers of harbor seals are taken in subsistence hunting in northern Canada (DFO 2011).

Table 3. Harbor seal (*Phoca vitulina vitulina*) stranding mortalities along the U.S. Atlantic coast (2010-2014) with subtotals of animals recorded as pups in parentheses[a].

| State | 2010 | 2011 | 2012 | 2013 | 2014 | Total |
|---|---|---|---|---|---|---|
| Maine[a] | 70 (64) | 147 (115) | 131 (101) | 99 (74) | 127 (94) | 574 |
| New Hamphire[a] | 20 (15) | 77 (63) | 24 (18) | 16 (6) | 35 (22) | 172 |
| Massachusetts[a] | 82 (26) | 133 (80) | 54 (35) | 95 (39) | 58 (15) | 422 |
| Rhode Island | 4 (0) | 7 (0) | 14 (0) | 9 (3) | 7 (1) | 41 |
| Connecticut | 0 | 1 (1) | 1 (1) | 2 (1) | 0 | 4 |
| New York | 15 (0) | 17 (0) | 14 (1) | 11 (2) | 13 (4) | 70 |
| New Jersey | 21 (0) | 10 (0) | 7 (0) | 4 (0) | 2 (1) | 44 |
| Delaware | 0 | 0 | 0 | 0 | 2 (0) | 2 |
| Maryland | 0 | 1 (0) | 0 | 1 (0) | 2 (0) | 4 |
| Virginia | 1 (0) | 4 (0) | 0 | 5 (0) | 2 (0) | 12 |
| North Carolina | 11 (1) | 2 (0) | 2 (0) | 3 (0) | 3 (1) | 21 |
| South Carolina | 1 | 0 | 0 | 0 | 1 (0) | 2 |
| **Total** | **225** | **399** | **247** | **245** | **252** | **1368** |
| Unspecified seals (all states) | 22 | 63 | 28 | 25 | 38 | 176 |

a. Unusual Mortality event (UME) declared for harbor seals in southern Maine to northern Massachusetts in 2011.

## STATUS OF STOCK

Harbor seals are not listed as threatened or endangered under the Endangered Species Act, and the western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. The 2010–2014 average annual human-caused mortality and serious injury does not exceed PBR. The status of the western North Atlantic harbor seal stock, relative to OSP, in the U.S. Atlantic EEZ is unknown. Total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate.

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# GRAY SEAL (*Halichoerus grypus atlantica*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal (*Halichoerus grypus atlantica*) is found on both sides of the North Atlantic, with three major populations: eastern Canada, northwestern Europe and the Baltic Sea (Katona *et al.* 1993). The western North Atlantic stock is equivalent to the eastern Canada population, and ranges from New Jersey to Labrador (Davies 1957; Mansfield 1966; Katona *et al.* 1993; Lesage and Hammill 2001). This stock is separated by geography, differences in the breeding season, and mitochondrial and nuclear DNA variation from the northeastern Atlantic stocks (Bonner 1981; Boskovic *et al.* 1996; Lesage and Hammill 2001; Klimova *et al.* 2014). There are three breeding aggregations in eastern Canada: Sable Island, Gulf of St. Lawrence, and along the coast of Nova Scotia (Laviguer and Hammill 1993). Outside the breeding period, there is overlap in the distribution of animals from the three colonies (Lavigueur and Hammill 1993; Harvey *et al.* 2008; Breed *et al.* 2006, 2009) and they are considered a single population based on genetic similarity (Boskovic *et al.* 1996; Wood *et al.* 2011). In the mid-1980s, small numbers of animals and pupping were observed on several isolated islands along the Maine coast and in Nantucket-Vineyard 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 US populations were examined for genetic variation using microsatellite loci (Wood et al. 2011). All individuals were identified as belonging to one population, confirming that recolonization by Canadian gray seals is the source of the U.S. population.

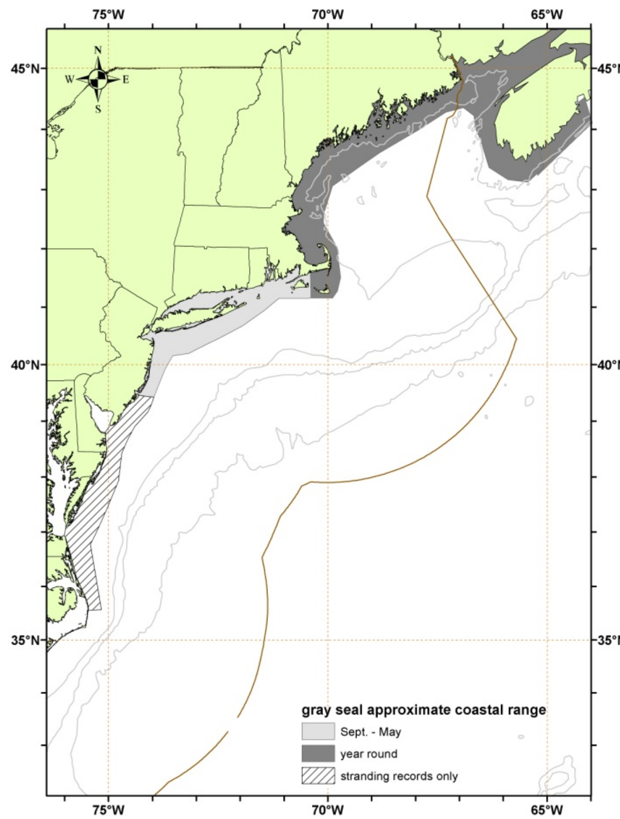


**Figure 1**. Approximate coastal range of gray seals. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.

## POPULATION SIZE

Current estimates of the total western Atlantic gray seal population are not available; although estimates of portions of the stock are available for select time periods. The Canadian gray seal stock assessment (DFO 2014) reports gray seal pup production in 2014 for the three Canadian aggregations (Gulf of St. Lawrence, Sable Island, and Nova Scotia) as 93,000 (95%CI=48,000-137,000) animals; these are projected using population models to total population levels of 505,000 (95%CI=329,000-682,000) animals.

In U.S. waters, gray seals primarily pup at four established colonies: Muskeget and Monomoy islands in Massachusetts, and Green and Seal islands in Maine. Since 2010 pupping has also been observed at Noman's Island in Massachusetts and Wooden Ball and Matinicus Rock in Maine. Although white-coated pups have stranded on eastern Long Island beaches, no pupping colonies have been detected in that region. Gray seals have been observed using the historic pupping site on Muskeget Island in Massachusetts since 1988. Pupping has taken place on Seal and Green Islands in Maine since at least the mid-1990s. Aerial survey data from these sites indicate that pup production is increasing (Table 2), although aerial survey quality and coverage has varied significantly among surveys. A minimum of 2,620 pups (Muskeget= 2,095, Green= 59, Seal= 466) were born in the U.S. in 2008 (Wood LaFond 2009). Table 2 summarizes single-day pup counts from three of the U.S. pupping colonies from 2001/2002 to 2007/2008 pupping periods.

There are several published counts of gray seals in the Northeast U.S. outside of the pupping season. In April–May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy Island combined (Rough 1995). Maine coast-wide surveys conducted during summer estimated 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert *et al.* 2005). In March 1999 a maximum count of 5,611 was obtained in the region south of Maine (between Isles of Shoals, Maine and Woods Hole, Massachusetts) (Barlas 1999).

Table 1. Summary of recent abundance estimates for the western North Atlantic gray seal (*Halichoerus grypus atlantica*) by year, and area covered during each abundance survey, resulting total abundance estimate and 95% confidence interval.

| **Month/Year** | **Area** | $N_{best}$ [a] | **CI** |
|---|---|---|---|
| 2012[b] | Gulf of St Lawrence + Nova Scotia Eastern Shore + Sable Island | 331,000 | 95% CI 263,000-458,000 |
| 2014[c] | Gulf of St Lawrence + Nova Scotia Eastern Shore + Sable Island | 505,000 | 95%CI=329,000-682,000 |

[a]These are model based estimates derived from pup surveys.
[b] DFO 2013
[c] DFO 2014

Table 2. Single day pup counts from three of the U.S. pupping colonies during 2001-2008 from aerial surveys. As single day pup counts, these counts do not represent the entire number of pups born in a pupping season.

| Pupping Season | Muskeget Island | Seal Island | Green Island |
|---|---|---|---|
| 2001-2 | 883 | No data | 34 |
| 2002-3 | 509 | 147 | No data |
| 2003-4 | 824 | 150 | 26 |
| 2004-5 | 992 | 365 | 33 |
| 2005-6 | 868 | 239 | 43 |
| 2006-7 | 1704 | 364 | 57 |
| 2007-8 | 2095 | 466 | 59 |

**Minimum Population Estimate**

Based on modeling, the total Canadian gray seal population was estimated to be 505,000 (95% CI = 329,000-682,000; DFO 2014). Present data are insufficient to calculate the minimum population estimate for U.S. waters.

**Current Population Trend**

Gray seal abundance is likely increasing in the U.S. Atlantic Exclusive Economic Zone (EEZ), but the rate of increase is unknown. An increasing trend in abundance in U.S. waters is supported by analysis of trends in gray seal strandings and bycatch records from the Northeastern U.S. (Johnston *et al.* 2015).

The population in eastern Canada was greatly reduced by hunting and bounty programs, and in the 1950s the gray seal was considered rare (Lesage and Hammill 2001). The Sable Island, Nova Scotia, population was less affected and has been increasing for several decades. Pup production on Sable Island increased exponentially at a rate of 12.8% per year between the 1970s and 1997 (Stobo and Zwanenburg 1990; Mohn and Bowen 1996; Bowen *et al.* 2003; Trzcinski *et al.* 2005; Bowen *et al.* 2007; DFO 2011). Recent population modeling indicates that the combined population increased at an annual rate of 5.2% between 2007 and 2010, and since then has continued to grow at a rate of 4.5% per year (DFO 2011, 2014). The non-Sable Island population increased from approximately 25,000 in the mid-1980s to a peak of 112,000 in 2014 (Thomas *et al.* 2011; DFO 2014). Modeling estimates of pup production increased from approximately 6,000 in 1985 to 21,500 in 2014 (Thomas *et al.* 2011; DFO 2014). Approximately 75% of the western North Atlantic population is from the Sable Island stock. In the early 1990s pupping was established on Hay Island, off the Cape Breton coast (Lesage and Hammill 2001; Hammill *et al*. 2007, Hamill and Stenson 2010).

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Recent studies estimated the current annual rate of increase at 4.5% for the combined breeding aggregations in Canada (DFO 2014), continuing a decline in the rate of increase (Trzcinski *et al*. 2005; Bowen *et al*. 2007; Thomas *et al*. 2011; DFO 2014). For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% 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 is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor ($F_R$) for this stock is 1.0, the value for stocks of unknown status, but which are known to be increasing. PBR for the portion of the western North Atlantic gray seal stock in U.S. waters is unknown.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2010–2014, the average annual estimated human caused mortality and serious injury to gray seals was 4,937 per year. The average was derived from six components: 1) 1,162 (CV=0.10) (Table 3) from the 2010–2014 U.S. observed fishery; 2) 7.8 from average 2010–2014 non-fishery related, human interaction stranding mortalities; 136 from average 2010–2014 kill in the Canadian hunt*;* 4) 82 from DFO scientific collections (DFO 2011); 5) 3,549 removals of nuisance animals in Canada (DFO 2014); and 6) 0.4 from U.S. research mortalities. . Analysis of bycatch rates from fisheries observer program records likely underestimates lethal (Lyle and Willcox 2008), and greatly under-represents sub-lethal, fishery interactions.

### Fishery Information

Detailed fishery information is given in Appendix III.

### U.S.

### Northeast Sink Gillnet

Gray seal bycatch in the northeast sink gillnet fishery were usually observed in the first half of the year in waters to the east and south of Cape Cod, Massachusetts in 12-inch gillnets fishing for skates and monkfish (Orphanides 2013; Hatch and Orphanides 2014, 2015, 2016). There were 7, 9, 1, 8, and 8 unidentified seals observed during 2010–2014, respectively. Since 1997 unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. See Table 3 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

Gray seal interactions were first observed in this fishery in 2010, since then, when they are observed, it is usually in waters off New Jersey in gillnets that have mesh sizes ≥ 7 in (Orphanides 2013; Hatch and Orphanides 2014, 2015, 2016). See Table 3 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

### Northeast Mid-Water Trawl

One gray seal mortality was observed in 2012 and one in 2013 in this fishery. An expanded bycatch estimate has not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2010–2014 is calculated as 0.4 animals (2 animals /5 years). See Table 3 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

### Mid-Atlantic Mid-Water Trawl

One gray seal mortality was observed in 2010 in this fishery. An expanded bycatch estimate has not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2010–2014 is calculated as 0.2 animals (1 animal /5 years). See Table 3 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**

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003, and was not observed in 2006. No mortalities have been observed, but during this time period 4 gray seals were captured and released alive in 2010, 34 in 2011, 33 in 2012, 1 in 2013, and 2 in 2014. In addition, during this time period 8 seals of unknown species were captured and released alive in 2011. See Table 3 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**

Vessels in the North Atlantic bottom trawl fishery, a Category III fishery under MMPA, were observed in order to meet fishery management, rather than marine mammal management needs. No mortalities were observed prior to 2005, when four mortalities were attributed to this fishery. See Table 2 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**

Three gray seal mortalities were observed in this fishery in 2011, 1 in 2012, 2 in 2013, and 1 in 2014 (Table 2). See Table 3 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

**CANADA**

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).

Table 3. Summary of the incidental serious injury and mortality of gray seal (*Halichoerus grypus atlantica*) by commercial fishery including the years sampled, the type of data used, the annual observer coverage, the serious injuries and mortalities recorded by on-board observers, the estimated annual mortality, the estimated CV of the annual mortality and the mean annual combined mortality (CV in parentheses).

| Fishery | Years | Data Type [a] | Observer Coverage [b] | Observed Serious Injury[e] | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Estimated CVs | Mean Annual Combined Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Sink Gillnet[c] | 10–14 | Obs. Data,Weighout, Trip Logbook | .17, .19, .15, .11, .18 | 0, 0, 0, 0, 0 | 107, 222, 91, 69, 159 | 0, 0, 0, 0, 0 | 1155, 1491, 542, 1,127, 917 | 1155, 1491, 542, 1,127, 917 | .28, .22, .19, .20, .14 | 1046 (0.10) |
| Mid-Atlantic Gillnet | 10–14 | Obs. Data, Trip Logbook, Allocated Dealer Data | .04, .02, .02, .03, .05 | 0, 0, 0, 0, 0 | 9, 2, 1 , 0, 1 | 0, 0, 0, 0, 0 | 267, 19, 14, 0, 22 | 267, 19, 14, 0, 22 | .75, .60, .98, 0, 1.09 | 64 (0.63) |
| Northeast Bottom Trawl [d] | 10–14 | Obs. Data,Trip Logbook | .16, .26, 17, .15, .17 | 0, 0, 0, 0, 0 | 9, 19, 8, 5, 4 | 0, 0, 0, 0, 0 | 30, 58, 37, 20, 19 | 30, 58, 37, 20, 19 | .34, .25, .49, .37, .45 | 33 (0.17) |
| Mid-Atlantic Bottom Trawl | 10–14 | Obs. Data,Trip Logbook | .06, .08, .05, .06, .08 | 0, 0, 0, 0, 0 | 0, 3, 1, 2, 1 | 0, 0, 0, 0, 0 | 0, 25, 30, 29, 7 | 0, 25, 30, 29, 7 | 0, .57, 1.1, .67, .96 | 18 (0.5) |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Northeast Mid-water Trawl - Including Pair Trawl | 10–14 | Obs. Data, Trip Logbook | .53, .41, .45, .37, .42 | 0, 0, 0, 0, 0 | 0, 0, 1, 1, 0 | 0, 0, 0, 0, 0 | 0, 0, na, na, 0 | 0, 0, na, na, 0 | 0, 0, na, na, 0 | 0.4 (na) [d] |
| Mid-Atlantic Mid-water Trawl - Including Pair Trawl | 10–14 | Obs. Data, Trip Logbook | .25, .41, .21, .07, .05 | 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) |
| TOTAL | | | | | | | | | | 1,162 (0.10) |

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 sink gillnet fishery.

b. The observer coverages for the northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed. North Atlantic bottom trawl mid-Atlantic bottom trawl, and mid-Atlantic mid-water trawl fishery coverages are ratios based on trips. Total observer coverage reported for bottom trawl gear and gillnet gear in the years 2010–2014 includes traditional fisheries observers in addition to fishery monitors through the Northeast Fisheries Observer Program (NEFOP).

c. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2010– 2014, respectively, 17, 125, 54, 38, and 85 takes were observed in nets with pingers. In 2010 -2014, respectively, 39, 90, 97, 10, 31, and 74 takes were observed in nets without pingers.

d. Fishery related bycatch rates for years 2010–2014 were estimated using an annual stratified ratio-estimator. These estimates replace the 2008-2011 annual estimates reported in the 2013 stock assessment report that were generated using a different method (Lyssikatos *et al.* 2015).

e. Serious injuries were evaluated for the 2010–2014 period using new guidelines (Waring *et al.* 2014, 2015; Wenzel *et al.* 2015, 2016)

**Other Mortality**

**U.S**

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 mortality include human interactions, storms, abandonment by the mother, disease, and shark predation. Mortalities caused by human interactions include research mortalities, boat strikes, fishing gear interactions, power plant entrainment, oil spill/exposure, harassment, and shooting. Seals entangled in netting have been reported at several major haul-out sites in the Gulf of Maine.

From 2010 to 2014, 521 gray seal stranding mortalities were recorded, extending from Maine to North Carolina (Table 4; NOAA National Marine Mammal Health and Stranding Response Database, accessed 08 October 2015). Most stranding mortalities were in Massachusetts, which is the center of gray seal abundance in U.S. waters. Sixty-one (12%) of the total stranding mortalities showed signs of human interaction (12 in 2010, 20 in 2011, 4 in 2012, and 17 in 2013, and 8 in 2014), 22 of which had some indication of fishery interaction (4 in 2010, 5 in 2011, 2 in 2012, 9 in 2013 and 2 in 2014). Ten gray seals are recorded in the stranding database during the 2010 to 2014 period as having been shot—1 in Maine and 2 in Massachusetts in 2010, 6 in Massachusetts in 2011, and none in 2012 – 2014.

**Canada**

Between 2010-2014, the average annual human caused mortality and serious injury to gray seals in Canadian waters from commercial harvest was 136 per year (DFO 2014; http://www.dfo-mpo.gc.ca/fm-gp/seal-phoque/statistics-eng.htm accessed 3/25/2016), though more is permitted (up to 60,000 seals/year, see http://www.dfo-mpo.gc.ca/decisions/fm-2015-gp/atl-001-eng.htm). This included: 58 in 2010, 215 in 2011, 218 in 2012, 106 in 2013, and 82 in 2014. In addition, between 2009 and 2013 (the most recent time series for nuisance removals), an average of 3,549 nuisance animals per year were killed. This included 5,218 in 2009, 1,853 in 2010, 1,722 in 2011, 5,428 in 2012, and 3,525 in 2013 (DFO 2014). Lastly, DFO took 320 animals in 2011 and 90 animals in 2012 for scientific collections (DFO 2014).

Table 4. Gray seal (*Halichoerus grypus atlantica*) stranding mortalities along the U.S. Atlantic coast (2010-2014) with subtotals of animals recorded as pups in parentheses.

| State | 2010 | 2011 | 2012 | 2013 | 2014 | Total |
|---|---|---|---|---|---|---|
| ME | 8 (4) | 4 (2) | 10 (2) | 9 (4) | 3 (1) | 34 |
| NH | 0 | 8 (1) | 1 (1) | 1 (0) | 3 (2) | 13 |
| MA | 43 (5) | 89 (14) | 38 (21) | 82 (8) | 62 (6) | 314 |
| RI | 8 (3) | 14 (2) | 13 (5) | 11 (2) | 8 (1) | 54 |
| CT | 0 | 2 (0) | 0 | 0 | 0 | 2 |
| NY | 10 (7) | 22 (6) | 5 (3) | 18 (5) | 7 (4) | 62 |
| NJ | 4 (1) | 10 (0) | 4 (0) | 7 (2) | 7 (6) | 32 |
| DE | 0 | 0 | 0 | 0 | 3 (3) | 3 |
| MD | 1 (0) | 4 (2) | 0 | 0 | 1 (0) | 6 |
| VA | 1 (0) | 1 (0) | 0 | 0 | 0 | 2 |
| NC | 1 (0) | 2 (2) | 0 | 0 | 2 (2) | 5 |
| Total | 76 (20) | 156 (29) | 71 (32) | 128 (21) | 96 (25) | 527 |
| Unspecified seals (all states) | 22 | 63 | 28 | 25 | 38 | 176 |

## STATUS OF STOCK

Gray seals are not listed as threatened or endangered under the Endangered Species Act, and the western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. The level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is low relative to the total stock size. The status of the gray seal population relative to OSP in U.S. Atlantic EEZ waters is unknown, but the stock's abundance appears to be increasing in Canadian and U.S. waters. The total U.S. fishery-related mortality and serious injury for this stock is low relative to the stock size in Canadian and U.S. waters and can be considered insignificant and approaching zero mortality and serious injury rate.

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# COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Northern Gulf of Mexico Bay, Sound, and Estuary Stocks

**NOTE – NMFS is in the process of writing individual stock assessment reports for each of the 31 bay, sound and estuary stocks of common bottlenose dolphins that are included in this report. Until this effort is completed and this report is replaced by 31 individual reports, basic information for all individual bay, sound and estuary stocks will remain in this report: "Northern Gulf of Mexico Bay, Sound and Estuary Stocks". To date, four stocks have individual reports completed (Barataria Bay Estuarine System; Mississippi Sound, Lake Borgne, Bay Boudreau; Choctawhatchee Bay; St. Joseph Bay) and the remaining 27 stocks are assessed in this report.**

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Common bottlenose dolphins are distributed throughout the bays, sound and estuaries of the Gulf of Mexico (Mullin 1988). The identification of biologically-meaningful "stocks" of bottlenose dolphins in these waters is complicated by the high degree of behavioral variability exhibited by this species (Shane *et al.* 1986; Wells and Scott 1999; Wells 2003), and by the lack of requisite information for much of the region.

Distinct stocks are delineated in each of 31 areas of contiguous, enclosed or semi-enclosed bodies of water adjacent to the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico; Table 1; Figure 1). The genesis of the delineation of these stocks was work initiated in the 1970s in Sarasota Bay, Florida (Irvine *et al.* 1981), and in bays in Texas (Shane 1977; Gruber 1981). These studies documented year-round residency of individual bottlenose dolphins in estuarine waters. As a result, the expectation of year-round resident populations was extended to bay, sound and estuary (BSE) waters across the northern Gulf of Mexico when the first stock assessment reports were established in 1995. Since these early studies, long-term (year-round, multi-year) residency has been reported from nearly every site where photographic identification (photo-ID) or tagging studies have been conducted in the Gulf of Mexico. In Texas, long-term resident dolphins have been reported in the Matagorda-Espiritu Santo Bay area (Gruber 1981; Lynn and Würsig 2002), Aransas Pass (Shane 1977; Weller 1998), San Luis Pass (Maze and Würsig 1999; Irwin and Würsig 2004), and Galveston Bay (Bräger 1993; Bräger *et al.* 1994; Fertl 1994). In Louisiana, Miller (2003) concluded the bottlenose dolphin population in the Barataria Basin was relatively closed. Hubard *et al.* (2004) reported sightings of dolphins in Mississippi Sound that were known from tagging efforts there 12–15 years prior. In Florida, long-term residency has been reported from Tampa Bay (Wells 1986; Wells *et al.* 1996b; Urian *et al.* 2009), Sarasota Bay (Irvine and Wells 1972; Irvine *et al.* 1981; Wells 1986; 1991; 2003; 2014; Wells *et al.* 1987; Scott *et al.* 1990; Wells 1991; 2003), Lemon Bay (Wells *et al.* 1996a; Bassos-Hull *et al.* 2013), Charlotte Harbor/Pine Island Sound (Shane 1990; Wells *et al.* 1996a; Wells *et al.* 1997; Shane 2004; Bassos-Hull *et al.* 2013) and Gasparilla Sound (Bassos-Hull *et al.* 2013). In Sarasota Bay, which has the longest research history, at least 5 concurrent generations of identifiable residents have been identified, including some of those first identified in 1970 (Wells 2014). Maximum immigration and emigration rates of about 2–3% have been estimated (Wells and Scott 1990).

Genetic data also support the concept of relatively discrete BSE stocks. Analyses of mitochondrial DNA haplotype distributions indicate the existence of clinal variations along the Gulf of Mexico coastline (Duffield and Wells 2002). Differences in reproductive seasonality from site to site also suggest genetic-based distinctions between communities (Urian *et al.* 1996). Mitochondrial DNA analyses suggest finer-scale structural levels as well. For example, dolphins in Matagorda Bay, Texas, appear to be a localized population, and differences in haplotype frequencies distinguish among adjacent communities in Tampa Bay, Sarasota Bay and Charlotte Harbor/Pine Island Sound, along the central west coast of Florida (Duffield and Wells 1991; 2002). Additionally, Sellas *et al.* (2005) examined population subdivision among dolphins sampled in Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, and the coastal Gulf of Mexico (1–12 km offshore) from just outside Tampa Bay to the southern end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of BSE populations from those occurring in adjacent Gulf coastal waters.

In many cases, residents occur primarily in BSE waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; 1990; Gruber 1981; Irvine *et al.* 1981; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006). These habitat use patterns are reflected in the ecology of the dolphins in some areas; for example, residents of Sarasota Bay, Florida, lacked squid in their diet, unlike non-resident dolphins stranded on nearby Gulf beaches (Barros and Wells 1998). However, in some areas year-round residents may co-occur with non-resident dolphins. For example, about 14–17% of group sightings involving resident Sarasota Bay dolphins include at least 1 non-resident as well (Wells *et al.* 1987; Fazioli *et al.* 2006). Mixing of inshore residents and non-residents has been seen at San Luis Pass, Texas (Maze and Würsig 1999), Cedar Keys, Florida (Quintana-Rizzo and Wells 2001), and Pine Island Sound, Florida (Shane 2004). Non-residents exhibit a variety of movement patterns, ranging from apparent nomadism recorded as transience to a given area, to apparent seasonal or non-seasonal migrations. Passes, especially the mouths of the larger estuaries, serve as mixing areas. For example, dolphins from several different areas were documented at the mouth of Tampa Bay, Florida (Wells 1986), and most of the dolphins identified in the mouths of Galveston Bay and Aransas Pass, Texas, were considered transients (Henningsen 1991; Bräger 1993; Weller 1998).

Seasonal movements of dolphins into and out of some of the bays, sounds and estuaries have also been documented. In Sarasota Bay, Florida, and San Luis Pass, Texas, residents have been documented moving into Gulf coastal waters in fall/winter, and returning inshore in spring/summer (Irvine *et al.* 1981; Maze and Würsig 1999). Fall/winter increases in abundance have been noted for Tampa Bay (Scott *et al.* 1989) and are thought to occur in Matagorda Bay (Gruber 1981; Lynn and Würsig 2002) and Aransas Pass (Shane 1977; Weller 1998). Spring/summer increases in abundance occur in Mississippi Sound (Hubard *et al.* 2004) and are thought to occur in Galveston Bay (Henningsen 1991; Bräger 1993; Fertl 1994).

Spring and fall increases in abundance have been reported for St. Joseph Bay, Florida. Mark-recapture abundance estimates were highest in spring and fall and lowest in summer and winter (Table 1; Balmer *et al.* 2008). Individuals with low site-fidelity indices were sighted more often in spring and fall, whereas individuals sighted during summer and winter displayed higher site-fidelity indices. In conjunction with health assessments, 23 dolphins were radio tagged during April 2005 and July 2006. Dolphins tagged in spring 2005 displayed variable utilization areas and variable site fidelity patterns. In contrast, during summer 2006 the majority of radio tagged individuals displayed similar utilization areas and moderate to high site-fidelity patterns. The results of the studies suggest that during summer and winter St. Joseph Bay hosts dolphins that spend most of their time within this region, and these may represent a resident community. In spring and fall, St. Joseph Bay is visited by dolphins that range outside of this area (Balmer *et al.* 2008).

The current BSE stocks are delineated as described in Table 1. There are some estuarine areas that are not currently part of any stock's range. Many of these are areas that dolphins cannot readily access. For example, the marshlands between Galveston Bay and Sabine Lake and between Sabine Lake and Calcasieu Lake are fronted by long, sandy beaches that prohibit dolphins from entering the marshes. The region between the Calcasieu Lake and Vermilion Bay/Atchafalaya Bay stocks has some access, but these marshes are predominantly freshwater rather than saltwater marshes, making them unsuitable for long-term survival of a viable population of bottlenose dolphins. In other regions, there is insufficient estuarine habitat to harbor a demographically independent population, for instance between the Matagorda Bay and West Bay Stocks in Texas, and/or sufficient isolation of the estuarine habitat from coastal waters. The regions between the south end of the Estero Bay Stock area to just south of Naples and between Little Sarasota Bay and Lemon Bay are highly developed and contain little appropriate habitat. South of Naples to San Marco Island and Gullivan Bay is also not currently covered in a stock boundary. This region may reasonably contain bottlenose dolphins, but the relationship of any dolphins in this region to other BSE stocks is unknown. They may be members of the Gullivan to Chokoloskee Bay stock as there is passage behind San Marco Island that would allow dolphins to move north. The regions between Apalachee Bay and Cedar Key/Waccasassa Bay, between Crystal Bay and St. Joseph Sound and between Chokoloskee Bay and Whitewater Bay are comprised of thin strips of marshland with no barriers to adjacent coastal waters. Further work is necessary to determine whether year-round resident dolphins use these thin marshes or whether dolphins in these areas are members of the coastal stock that use the fringing marshland as well. Finally, the region between the eastern border of the Barataria Bay Stock and the Mississippi Delta Stock to the east may harbor dolphins, but the area is small and work is necessary to determine whether any dolphins utilizing this habitat come from an adjacent BSE stock.

As more information becomes available, combination or division of these stocks, or alterations to stock boundaries, may be warranted. Recent research based on photo-ID data collected by Bassos-Hull *et al.* (2013) recommended combining B21, Lemon Bay, with B22–23, Gasparilla Sound, Charlotte Harbor, Pine Island Sound. Therefore, these stocks have been combined (see Table 1). However, it should be noted this change was made in the absence of genetic data and could be revised again in the future when genetic data are available. Additionally, a number of geographically and socially distinct subgroupings of dolphins in regions such as Tampa Bay, Charlotte Harbor, Pine Island Sound, Aransas Pass and Matagorda Bay have been identified, but the importance of these distinctions to stock designations remains undetermined (Shane 1977; Gruber 1981; Wells *et al.* 1996a; 1996b;

1997; Lynn and Würsig 2002; Urian 2002). For Tampa Bay, Urian *et al.* (2009) described 5 discrete communities (including the adjacent Sarasota Bay community) that differed in their social interactions and ranging patterns. Structure was found despite a lack of physiographic barriers to movement within this large, open embayment. Urian *et al.* (2009) further suggested that fine-scale structure may be a common element among bottlenose dolphins in the southeastern U.S. and recommended that management should account for fine-scale structure that exists within current stock designations.

Table 1. Most recent common bottlenose dolphin abundance ($N_{BEST}$), coefficient of variation (CV) and minimum population estimate ($N_{MIN}$) in northern Gulf of Mexico bays, sounds and estuaries. Because they are based on data collected more than 8 years ago, most estimates are considered unknown or undetermined for management purposes. Blocks refer to aerial survey blocks illustrated in Figure 1. PBR – Potential Biological Removal; UNK – unknown; UND – undetermined.

| Blocks | Gulf of Mexico Estuary | $N_{BEST}$ | CV | $N_{MIN}$ | PBR | Year | Reference |
|---|---|---|---|---|---|---|---|
| B51 | Laguna Madre | 80 | 1.57 | UNK | UND | 1992 | A |
| B52 | Nueces Bay, Corpus Christi Bay | 58 | 0.61 | UNK | UND | 1992 | A |
| B50 | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay | 55 | 0.82 | UNK | UND | 1992 | A |
| B54 | Matagorda Bay, Tres Palacios Bay, Lavaca Bay | 61 | 0.45 | UNK | UND | 1992 | A |
| B55 | West Bay | 32 | 0.15 | UNK | UND | 2001 | B |
| B56 | Galveston Bay, East Bay, Trinity Bay | 152 | 0.43 | UNK | UND | 1992 | A |
| B57 | Sabine Lake | 0[a] | - | | UND | 1992 | A |
| B58 | Calcasieu Lake | 0[a] | - | | UND | 1992 | A |
| B59 | Vermilion Bay, West Cote Blanche Bay, Atchafalaya Bay | 0[a] | - | | UND | 1992 | A |
| B60 | Terrebonne Bay, Timbalier Bay | 100 | 0.53 | UNK | UND | 1993 | A |
| B61 | Barataria Bay† | 138 | 0.08 | UNK | UND | 2001 | C |
| B30 | Mississippi River Delta | 332 | 0.93 | 170 | 1.7 | 2011–12 | D |
| B02–05, 29, 31 | Mississippi Sound, Lake Borgne, Bay Boudreau† | 901 | 0.63 | 551 | 5.6 | 2012 | D |
| B06 | Mobile Bay, Bonsecour Bay | 122 | 0.34 | UNK | UND | 1993 | A |
| B07 | Perdido Bay | 0[a] | - | | UND | 1993 | A |
| B08 | Pensacola Bay, East Bay | 33 | 0.80 | UNK | UND | 1993 | A |
| B09 | Choctawhatchee Bay† | 179 | 0.04 | UNK[c] | UND[c] | 2007 | E |
| B10 | St. Andrew Bay | 124 | 0.57 | UNK | UND | 1993 | A |
| B11 | St. Joseph Bay† | 152 | 0.08 | UNK[c] | UND[c] | 2007 | F |
| B12–13 | St. Vincent Sound, Apalachicola Bay, St. George Sound | 439 | 0.14 | UNK | UND | 2007 | G |
| B14–15 | Apalachee Bay | 491 | 0.39 | UNK | UND | 1993 | A |
| B16 | Waccasassa Bay, Withlacoochee Bay, Crystal Bay | UNK | - | UNK | UND | | |
| B17 | St. Joseph Sound, Clearwater Harbor | UNK | - | UNK | UND | | |
| B32–34 | Tampa Bay | UNK | - | UNK | UND | | |
| B20, 35 | Sarasota Bay, Little Sarasota Bay | 158 | 0.27 | 126 | 1.3 | 2015 | H |
| B21–23 | Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay | 826 | 0.09 | UNK | UND | 2006 | I |
| B36 | Caloosahatchee River | 0[a,b] | - | | UND | 1985 | J |
| B24 | Estero Bay | UNK | - | UNK | UND | | |
| B25 | Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay | UNK | - | UNK | UND | | |
| B27 | Whitewater Bay | UNK | - | UNK | UND | | |
| B28 | Florida Keys (Bahia Honda to Key | UNK | - | UNK | UND | | |

| |
|---|
| West) |
| References: A – Blaylock and Hoggard 1994; B – Irwin and Würsig 2004; C – Miller 2003; D – Garrison 2017; E – Conn *et al.* 2011; F – Balmer *et al.* 2008; G – Tyson *et al.* 2011; H – Tyson and Wells 2016; I – Bassos-Hull *et al.* 2013; J –Scott *et al.* 1989<br>Notes:<br>[a] During earlier surveys (Scott *et al.* 1989), the range of seasonal abundances was as follows: B57, 0–2 (CV=0.38); B58, 0–6 (0.34); B59, 0–0; B30, 0–182 (0.14); B07, 0–0; B21, 0–15 (0.43); and B36, 0–0.<br>[b] Block not surveyed during surveys reported in Blaylock and Hoggard (1994).<br>[c] The individual SAR for this stock has not been updated yet to reflect this change.<br>†An individual stock assessment report is available for this stock. |

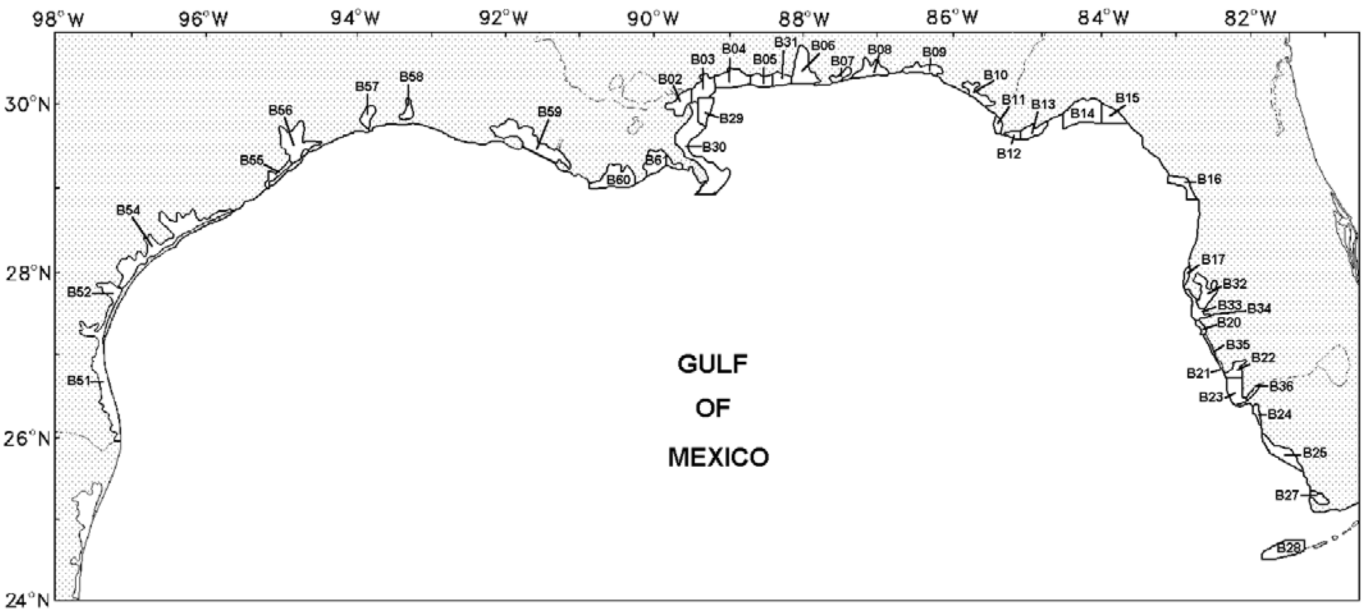


Figure 1. *Northern Gulf of Mexico bays, sounds and estuaries. Each of the alpha-numerically designated blocks corresponds to one of the NMFS Southeast Fisheries Science Center logistical aerial survey areas listed in Table 1. The common bottlenose dolphins inhabiting each bay, sound or estuary are considered to comprise a unique stock for purposes of this assessment. Four stocks have their own stock assessment report (see Table 1).*

## POPULATION SIZE

Population size estimates for most of the stocks are greater than 8 years old and therefore the current population sizes for all but 3 of these stocks are considered unknown (Wade and Angliss 1997). However, a capture-mark-recapture population size estimate for 2015 is available for Sarasota Bay, Little Sarasota Bay (Tyson and Wells 2016). Recent aerial survey line-transect population size estimates are available for Mississippi River Delta and Mississippi Sound, Lake Borgne, Bay Boudreau (Garrison 2017; Table 1). Population size estimates for many stocks were generated from preliminary analyses of line-transect data collected during aerial surveys conducted in September-October 1992 in Texas and Louisiana and in September–October 1993 in Louisiana, Mississippi, Alabama and the Florida Panhandle (Blaylock and Hoggard 1994; Table 1). Standard line-transect perpendicular sighting distance analytical methods (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) were used.

### Minimum Population Estimate

The population sizes for all but 3 stocks are currently unknown and the minimum population estimates are given for those 3 stocks in Table 1. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The minimum population estimate was calculated for each block from the estimated population size and its associated coefficient of variation.

**Current Population Trend**

The data are insufficient to determine population trends for most of the Gulf of Mexico BSE common bottlenose dolphin stocks.

## CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for these stocks. 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 (Wade and Angliss 1997). The recovery factor is 0.5 because these stocks are of unknown status. PBR is undetermined for all but 3 stocks because the population size estimates are more than 8 years old. PBR for those stocks with population size estimates less than 8 years old is given in Table 1.

## ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for these stocks during 2010–2014 is unknown because these stocks interact with unobserved fisheries (see below). Five-year unweighted mean mortality estimates for 2007–2011 for the commercial shrimp trawl fishery were calculated at the state level (see Shrimp Trawl section below).

**Fishery Information**

The commercial fisheries that interact, or that potentially could interact, with these stocks in the Gulf of Mexico are the Category II Southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl; Gulf of Mexico menhaden purse seine; Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot; and Gulf of Mexico gillnet fisheries; and the Category III Gulf of Mexico blue crab trap/pot; Florida spiny lobster trap/pot; and Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fisheries (Appendix III).

In the following sections the number of documented interactions of common bottlenose dolphins with each of these fisheries during 2010–2014 is reported. The likely stock(s) of origin for each interaction has been inferred based on the location of the interaction and distribution of the fishery.

**Shrimp Trawl**

During 2010–2014, there were no documented mortalities or serious injuries of common bottlenose dolphins from Gulf of Mexico BSE stocks by commercial shrimp trawls because observer coverage of this fishery does not include BSE waters. Between 1997 and 2011, 5 common bottlenose dolphins and 7 unidentified dolphins, which could have been either common bottlenose dolphins or Atlantic spotted dolphins, became entangled in the lazy line, turtle excluder device or tickler chain gear in the commercial shrimp trawl fishery in the Gulf of Mexico. All dolphin bycatch interactions resulted in mortalities except for 1 unidentified dolphin that was released alive in 2009. Soldevilla *et al.* (2015) provided mortality estimates calculated from analysis of shrimp fishery effort data and NMFS's Observer Program bycatch data. Observer program coverage does not extend into BSE waters; time-area stratified bycatch rates were extrapolated into inshore waters to estimate bycatch mortalities from inshore fishing effort. Annual mortality estimates were calculated for the years 1997–2011 from stratified annual fishery effort and bycatch rates, and a 5-year unweighted mean mortality estimate for 2007–2011 was calculated for Gulf of Mexico dolphin stocks. The 4-area (Texas, Louisiana, Mississippi/Alabama, Florida) stratification method was chosen because it best approximates how fisheries operate (Soldevilla *et al.* 2015). The BSE stock mortality estimates were aggregated at the state level as this was the spatial resolution at which fishery effort is modeled (e.g., Nance *et al.* 2008). The mean annual mortality estimates for the BSE stocks were as follows: Texas BSE (from Galveston Bay, East Bay, Trinity Bay south to Laguna Madre): 0; Louisiana BSE (from Sabine Lake east to Barataria Bay): 88 (CV=1.01); Mississippi/Alabama BSE (from Mississippi River Delta east to Mobile Bay, Bonsecour Bay): 41 (CV=0.67); and Florida BSE (from Perdido Bay east and south to the Florida Keys): 3.4 (CV=0.99). These estimates do not include skimmer trawl effort, which may represent up to 50% of shrimp fishery effort in Louisiana, Alabama, and Mississippi inshore waters, because observer program coverage of skimmer trawls is limited. Limitations and biases of annual bycatch mortality estimates are described in detail in Soldevilla *et al.* (2015).

One mortality (2009) and 1 live release without serious injury (2012) occurred in Alabama bays during non-commercial shrimp trawling (see "Other Mortality" below for details).

**Menhaden Purse Seine**

During 2010–2014, there were 2 mortalities and 1 animal released alive without serious injury documented within BSE waters involving the menhaden purse seine fishery. All 3 interactions occurred within the waters of the Mississippi Sound, Lake Borgne, Bay Boudreau Stock (also reported in that SAR).

There is currently no observer program for the Gulf of Mexico menhaden purse seine fishery; however, recent incidental takes have been reported via two sources. First, during 2011, a pilot observer program operated from May through September, and observers documented 3 dolphins trapped within purse seine nets. All 3 were released alive without serious injury (Maze-Foley and Garrison 2016a). Two of the 3 dolphins were trapped within a single purse seine within waters of the Western Coastal Stock. The third animal was trapped in waters of the Mississippi Sound, Lake Borgne, Bay Boudreau Stock. Second, through the Marine Mammal Authorization Program (MMAP), there have been 13 self-reported incidental takes (all mortalities) of common bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery during 2000–2014. Specific self-reported takes under the MMAP likely involving BSE stocks are as follows: 2 dolphins were reported taken in a single purse seine during 2012 in Mississippi Sound (Mississippi Sound, Lake Borgne, Bay Boudreau Stock); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2004 that likely belonged to the Mississippi River Delta Stock; 1 take of a single unidentified dolphin reported during 2002 likely belonged to the Mississippi Sound, Lake Borgne, Bay Boudreau Stock; 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2001 that likely belonged to Mississippi River Delta Stock or Northern Coastal Stock; during 2000, 1 take of a single bottlenose dolphin was reported in Louisiana waters that likely belonged to Mississippi River Delta Stock or Northern Coastal Stock; and also in 2000, 3 bottlenose dolphins were reported taken in a single purse seine in Mississippi waters that likely belonged to Mississippi Sound, Lake Borgne, Bay Boudreau Stock.

Without an ongoing observer program, it is not possible to obtain statistically reliable information for this fishery on the incidental take and mortality rates, and the stocks from which bottlenose dolphins are being taken.

**Blue Crab, Stone Crab and Florida Spiny Lobster Trap/Pot**

During 2010–2014 there were 4 documented interactions with trap/pot fisheries and BSE stocks. During 2013, 1 animal was disentangled and released alive from Florida spiny lobster trap/pot gear (it could not be determined if the animal was seriously injured following mitigation (disentanglement) efforts; the initial determination (pre-mitigation) was seriously injured [Maze-Foley and Garrison 2016c]). This animal likely belonged to the Florida Keys Stock. During 2011, 1 mortality occurred and 1 live animal was disentangled and released (it could not be determined if the animal was seriously injured [Maze-Foley and Garrison 2016a]). The BSE stocks involved were likely Waccasassa Bay, Withlacoochee Bay, Crystal Bay and Galveston Bay, East Bay, Trinity Bay, respectively. In 2010, a calf likely belonging to the Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay Stock was disentangled by stranding network personnel from a crab trap line wrapped around its peduncle. The animal swam away with no obvious injuries, but was considered seriously injured because it is unknown whether it was reunited with its mother (Maze-Foley and Garrison 2016a). The specific fishery could not be identified for the trap/pot gear involved in the 2011 and 2010 interactions. All mortalities and animals released alive were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015) and are included in the stranding totals in Table 1. Because there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

**Gillnet**

No marine mammal mortalities associated with gillnet fisheries have been reported or observed in recent years, but stranding data suggest that gillnet and marine mammal interactions do occur, causing mortality and serious injury. During 2010–2014, a total of 12 entanglements in research-related gillnets were reported in BSE stocks: 8 dolphins in Texas, 2 in Louisiana and 2 in Florida. Three of the 12 entanglements resulted in mortalities, and 1 in a serious injury (see “Other Mortality” below for details on recent and historical research-related entanglements).

There has been no observer coverage of this fishery in federal waters. Beginning in November 2012, NMFS began placing observers on commercial vessels in the coastal waters of Alabama, Mississippi and Louisiana (state waters only). No takes have been observed to date (Mathers *et al.* 2016). In 1995, a Florida state constitutional amendment banned gillnets and large nets from bays, sounds, estuaries and other inshore waters. Commercial and recreational gillnet fishing is also prohibited in Texas state waters.

**Hook and Line (Rod and Reel)**

During 2010–2014 there were 29 documented interactions (entanglements or ingestions) with hook and line gear and BSE stocks—20 mortalities and 9 live animals for which disentanglement efforts were made. Available evidence from stranding data was examined for the 20 mortalities. For 12 of these mortalities, evidence suggested the hook and line gear interaction contributed to the cause of death. For 4 mortalities, evidence suggested the hook and line gear interaction was incidental and was not a contributing factor to cause of death. For 4 mortalities, it could not be determined if the hook and line gear interaction contributed to cause of death. Attempts were made to disentangle 9 live animals from hook and line gear, 2 of which were considered seriously injured by the gear based on observations during mitigation (disentanglement) efforts. Four live animals were considered seriously injured by the gear prior to mitigation efforts, but based on observations during mitigations, they were considered not seriously injured post-mitigation. For the remaining 3 live animals, it could not be determined if the animals were seriously injured (Maze Foley and Garrison 2016a,b,c,d). In summary, the evidence available from stranding data suggested that at least 12 mortalities and 2 serious injuries to animals from BSE stocks were a result of interactions with rod and reel hook and line gear.

Interactions by year with hook and line gear were as follows: During 2010 there were 3 mortalities, and 1 live animal was disentangled and released, considered seriously injured (Maze-Foley and Garrison 2016a). During 2011, there were 2 mortalities, and 2 live animals were disentangled from hook and line gear. One of the live animals was considered seriously injured, and 1 was not seriously injured (Maze-Foley and Garrison 2016a). During 2012 there were 8 mortalities, and 2 live animals were disentangled from hook and line gear (1 considered not seriously injured, 1 could not be determined if it was seriously injured) (Maze-Foley and Garrison 2016b). During 2013 there were 3 mortalities and 3 live animals disentangled from hook and line gear. One of the live animals was considered not seriously injured and for the other 2, it could not be determined whether they were seriously injured (Maze-Foley and Garrison 2016c). Finally, during 2014 there were 4 mortalities and 1 live animal disentangled from hook and line gear considered not seriously injured (Maze-Foley and Garrison 2016d).

The mortalities and serious injuries likely involved animals from the following BSE stocks: Pensacola Bay, East Bay; Waccasassa Bay, Withlacoochee Bay, Crystal Bay; Tampa Bay; Sarasota Bay, Little Sarasota Bay; Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay; Caloosahatchee River; Estero Bay; Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay; Galveston Bay, East Bay, Trinity Bay; West Bay; Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay; and Neuces Bay, Corpus Christi Bay.

All mortalities and live entanglements were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015) and are included in the stranding totals presented in Table 1. It should be noted that, in general, it cannot be determined if rod and reel hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no systematic observer program.

**Strandings**

A total of 564 common bottlenose dolphins were found stranded within bays, sounds and estuaries of the northern Gulf of Mexico from 2010 through 2014 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). It could not be determined if there was evidence of human interaction for 452 of these strandings. For 27 dolphins, no evidence of human interaction was detected. Evidence of human interactions was detected for 85 of these dolphins. Human interactions were from numerous sources, including 29 entanglements with hook and line gear, 4 entanglements with trap/pot gear, 12 incidental takes in research gillnet gear, 1 stabbing with a screwdriver, 2 animals shot by arrow and 1 with gunshot, 1 entanglement in a non-commercial shrimp trawl, 1 entanglement in research longline gear, 2 strandings with visible, external oil, and 1 entrapment between oil booms (see Table 1). Strandings with evidence of fishery-related interactions are reported above in the respective gear sections. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998, 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

There are a number of difficulties associated with the interpretation of stranding data. Except in rare cases, such as Sarasota Bay, Florida, where residency can be determined, it is possible that some or all of the stranded dolphins may have been from a nearby coastal stock. However, the proportion of stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcasses originated. Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al*. 2012; Wells *et al*. 2015). Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al*. 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

Since 1990, there have been 13 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/events.html, accessed 11 January 2016). 1) From January through May 1990, a total of 344 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded number of strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992), however, morbillivirus may have contributed to this event (Litz *et al.* 2014). 2) A UME was declared for Sarasota Bay, Florida, in 1991 involving 31 bottlenose dolphins. The cause was not determined, but it is believed biotoxins may have contributed to this event (Litz *et al.* 2014). 3) In March and April 1992, 119 bottlenose dolphins stranded in Texas - about 9 times the average number. The cause of this event was not determined, but low salinity due to record rainfall combined with pesticide runoff and exposure to morbillivirus were suggested as potential contributing factors (Duignan *et al.* 1996; Colbert *et al.* 1999; Litz *et al.* 2014). 4) In 1993–1994 a UME of bottlenose dolphins caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994; Litz *et al.* 2014). From February through April 1994, 236 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. 5) In 1996 a UME was declared for bottlenose dolphins in Mississippi when 31 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible (Litz *et al.* 2014). 6) Between August 1999 and May 2000, 150 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesoplodon densirostris*, and 4 unidentified dolphins. Brevetoxin was determined to be the cause of this event (Twiner *et al.* 2012; Litz *et al.* 2014). 7) In March and April 2004, in another Florida Panhandle UME attributed to *K. brevis* blooms, 105 bottlenose dolphins and 2 unidentified dolphins stranded dead (Litz *et al.* 2014). Although there was no indication of a *K. brevis* bloom at the time, high levels of brevetoxin were found in the stomach contents of the stranded dolphins (Flewelling *et al.* 2005; Twiner *et al.* 2012). 8) In 2005, a particularly destructive red tide (*K. brevis*) bloom occurred off central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in November 2006. In total, 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and 23 unidentified dolphins). The evidence suggests a red tide bloom contributed to the cause of this event (Litz *et al.* 2014). 9) A separate UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of most of the stranded dolphins and determined to be the cause of the event (Twiner *et al.* 2012; Litz *et al.* 2014). Between September 2005 and April 2006 when the event was officially declared over, a total of 88 bottlenose dolphin strandings occurred (plus strandings of 5 unidentified dolphins). 10) During February and March of 2007 an event was declared for northeast Texas and western Louisiana involving 64 bottlenose dolphins and 2 unidentified dolphins. Decomposition prevented conclusive analyses on most carcasses (Litz *et al.* 2014). 11) During February and March of 2008 an additional event was declared in Texas involving 111 bottlenose dolphin strandings (plus strandings of 1 unidentified dolphin and 1 melon-headed whale, *Peponocephala electra*). Most of the animals recovered were in a decomposed state. The investigation is closed and a direct cause could not be identified. However, there were numerous, co-occurring harmful algal bloom toxins detected during the time period of this UME which may have contributed to the mortalities (Fire *et al.* 2011). 12) A UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010 and ending 31 July 2014 (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm, accessed 1 June 2016). The UME began a few months prior to the *Deepwater Horizon* (DWH) oil spill, however most of the strandings prior to May 2010 were in Lake Pontchartrain, Louisiana, and western Mississippi and were likely a result of low salinity and cold temperatures (Venn Watson *et al.* 2015a). The largest increase in strandings (compared to historical data) occurred after May 2010 following the DWH spill, and strandings were focused in areas exposed to DWH oil. Investigations to date have determined that the DWH oil spill is the primary underlying cause of the elevated stranding numbers in the northern Gulf of Mexico after the spill (e.g., Schwacke *et al.* 2014; Venn-Watson *et al.* 2015b). 13) A UME occurred from November 2011 to March 2012 across 5 Texas counties and included 126 bottlenose dolphin strandings. The strandings were coincident with a harmful algal bloom of *K. brevis*, but researchers have not determined that was the cause of the event. During 2011, 6 animals from BSE stocks were considered to be part of the UME; during 2012, 24 animals.

Table 2. Common bottlenose dolphin strandings occurring in bays, sounds and estuaries in the northern Gulf of Mexico from 2010 to 2014, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 15 June 2015). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that this table does not include strandings from Barataria Bay Estuarine System; Mississippi Sound, Lake Borgne, Bay Boudreau; Choctawhatchee Bay; or St. Joseph Bay.

| **Stock** | **Category** | **2010** | **2011** | **2012** | **2013** | **2014** | **Total** |
|---|---|---|---|---|---|---|---|
| Bay, Sound and Estuary | Total Stranded | 96[a] | 106[b] | 124[c] | 131[d] | 107[e] | 564 |
| | Human Interaction | | | | | | |
| | ---Yes | 15[f] | 13[g] | 23[h] | 22[i] | 12[j] | 85 |
| | ---No | 7 | 6 | 4 | 4 | 6 | 27 |
| | ---CBD | 74 | 87 | 97 | 105 | 89 | 452 |

[a] This total includes animals that are part of the Northern Gulf of Mexico UME.

[b] This total includes animals that are part of the Northern Gulf of Mexico UME, and also includes 6 animals that were part of the 2011–2012 UME in Texas.

[c] This total includes animals that are part of the Northern Gulf of Mexico UME, and also includes 24 animals that were part of the 2011–2012 UME in Texas.

[d] This total includes animals that are part of the Northern Gulf of Mexico UME.

[e] This total includes animals that are part of the Northern Gulf of Mexico UME.

[f] Includes 4 entanglement interactions with hook and line gear (3 mortalities and 1 animal released alive seriously injured); 1 entanglement interaction with unidentified trap/pot gear (released alive seriously injured); 2 entanglement interactions with research gillnet gear (1 released alive without serious injury, 1 released alive that could not be determined if seriously injured or not); 1 live release without serious injury following entrapment between oil booms (animal was initially seriously injured, but due to mitigation efforts, was released without serious injury); 1 animal visibly oiled (mortality); and 1 entanglement interaction with unknown gear (released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]) .

[g] Includes 4 entanglement interactions with hook and line gear (2 mortalities, 1 animal released alive seriously injured, 1 released alive without serious injury [this animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]); 2 entanglement interactions with research gillnet gear (1 mortality, 1 released alive without serious injury); 2 entanglement interactions with trap/pot gear (1 mortality, 1 released alive that could not be determined if seriously injured or not); and 1 animal visibly oiled (mortality).

[h] Includes 10 entanglement interactions with hook and line gear (8 mortalities, 1 released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury], 1 released alive that could not be determined if seriously injured or not); 4 entanglement interactions with research gillnet gear (1 released alive seriously injured, 3 released alive without serious injury); 1 entanglement in a non-commercial shrimp trawl net (released alive without serious injury); 1 stabbing (mortality); and 1 entanglement interaction with unknown fishing gear (released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]).

[i] Includes 6 entanglement interactions with hook and line gear (3 mortalities, 1 animal released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury], 2 animals released alive that could not be determined if seriously injured or not); 4 entanglement interactions with research gillnet gear (2 mortalities, 1 animal released alive without serious injury, 1 animal released alive that could not be determined if seriously injured or not); 1 interaction with Florida spiny lobster trap/pot gear (released alive, could not be determined if seriously injured or not [this animal was initially seriously injured, but mitigation efforts were made]); 1 interaction with research longline gear (released alive, seriously injured); and 1 animal that was gunshot (mortality).

[j] Includes 5 entanglement interactions with hook and line gear (4 mortalities, 1 released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]) and 2 animals shot by arrow (mortalities).

**Other Mortality**

There were 3 live dolphins included in the stranding database during 2010–2014 that were entangled in unidentified fishing gear or unidentified gear. One animal was seriously injured in 2013 in the Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay Stock area (Maze-Foley and Garrison 2016c). Two animals were initially considered seriously injured, but following mitigation efforts, were released alive without serious injury in 2010 (Sarasota Bay, Little Sarasota Bay Stock) and 2012 (Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay Stock) (Maze-Foley and Garrison 2016a,b). In addition, during 2012 in Alabama (Perdido Bay Stock), a dolphin was disentangled from a shrimp trawling net being used in a local ecotour. The animal was considered not seriously injured (Maze-Foley and Garrison 2016b), and was also included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015).

In addition to animals included in the stranding database, during 2010–2014, there were 20 at-sea observations in BSE stock areas of common bottlenose dolphins entangled in fishing gear or unidentified gear (hook and line, crab trap/pot and unidentified gear/line/rope). In 8 of these cases the animals were seriously injured, in 1 case the animal was not seriously injured, and for the remaining 11 cases, it could not be determined (CBD) if the animals were seriously injured (Maze-Foley and Garrison 2016a,b,c,d; see Table 3).

Table 3. At-sea observations of common bottlenose dolphins entangled in fishing gear or unidentified gear during 2010–2014, including the serious injury determination (mortality, serious injury, not a serious injury, or could not be determined (CBD) if seriously injured) and stock to which each animal likely belonged based on sighting location. Further details can be found in Maze-Foley and Garrison (2016a,b,c,d).

| **Year** | **Determination** | **Stock** |
|---|---|---|
| 2010 | Serious injury | Mobile Bay, Bonsecour Bay |
| 2010 | CBD | Terrebonne, Timbalier Bay |
| 2011 | Serious injury | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay |
| 2011 | Serious injury | Pensacola Bay, East Bay |
| 2011 | CBD | Tampa Bay |
| 2012 | Serious injury | Caloosahatchee River |
| 2012 | Serious injury | Sarasota Bay, Little Sarasota Bay |
| 2012 | CBD | Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay |
| 2012 | CBD | Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay |
| 2012 | CBD | Tampa Bay |
| 2013 | Serious injury | Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay |
| 2013 | Serious injury | Estero Bay |
| 2013 | Not serious | Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay |
| 2013 | CBD | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay |
| 2013 | CBD | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay |
| 2013 | CBD | Tampa Bay |
| 2013 | CBD | Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay |
| 2014 | Serious injury | St. Joseph Sound, Clearwater Harbor |
| 2014 | CBD | Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay |
| 2014 | CBD | St. Andrew Bay |

Common bottlenose dolphins are also known to interact with research-fishery gear. During 2010–2014, a dolphin was seriously injured during a research longline survey (Maze-Foley and Garrison 2016c; see Table 4) and 12 dolphins were entangled in research-related gillnets—in Texas (8), Louisiana (2) and Florida (2). Three of the 12 entanglements resulted in mortalities; 1 entanglement resulted in a serious injury; 6 entanglements were released alive without serious injury; and for 2 entanglements, it could not be determined if the animals were seriously injured (Maze-Foley and Garrison 2016a,b,c,d; see Table 4). All of the interactions with research gear were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015).

Table 4. Research-related takes of common bottlenose dolphins during 2010–2014, including the serious injury determination for each animal (mortality, serious injury, not a serious injury, or could not be determined (CBD) if seriously injured) and stock to which each animal likely belonged based on location of the interaction. All of these interactions were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). Further details on injury determinations can be found in Maze-Foley and Garrison (2016a,b,c,d).

| Year | Gear Type | Determination | Stock |
|---|---|---|---|
| 2013 | Longline | Serious injury | Mobile Bay, Bonsecour Bay |
| 2010 | Gillnet | Not serious | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay |
| 2010 | Gillnet | CBD | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay |
| 2011 | Gillnet | Mortality | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay |
| 2011 | Gillnet | Not serious | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay |
| 2012 | Gillnet | Serious injury | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay |
| 2012 | Gillnet | Not serious | Neuces Bay, Corpus Christi Bay |
| 2012 | Gillnet | Not serious | Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay |
| 2012 | Gillnet | Not serious | Laguna Madre |
| 2013 | Gillnet | Not serious | Mississippi River Delta |
| 2013 | Gillnet | Mortality | Mississippi River Delta |
| 2013 | Gillnet | Mortality | Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay |
| 2013 | Gillnet | CBD | Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay |

The problem of dolphin depredation of fishing gear is increasing in Gulf of Mexico coastal and estuary waters. There was a recent case within BSE waters of a shrimp fisherman illegally taking a common bottlenose dolphin in Mississippi Sound (Mississippi Sound, Lake Borgne, Bay Boudreau Stock) during summer 2012. In December 2013 the fisherman was convicted under the MMPA for knowingly shooting a dolphin with a shotgun while shrimping.

In addition to the above case where it was confirmed the fisherman retaliated against depredation by dolphins, there have been several other documented shootings of BSE common bottlenose dolphins in recent years, both by arrows and guns. During 2014 in Cow Bayou, Texas (Sabine Lake Stock), a dolphin was shot with a compound bow resulting in mortality. In 2014 near Orange Beach, Alabama (Perdido Bay Stock), a dolphin was shot with a hunting arrow. In the arrow cases, there was no evidence the acts were committed due to dolphin depredation of fishing gear. In 2014 within Choctawhatchee Bay, Florida (Choctawhatchee Bay Stock), a pregnant bottlenose dolphin was found dead with a bullet lodged in its lung. Necropsy results indicated the dolphin died of the gunshot wound. Two individual bottlenose dolphins were shot with buckshot-like ammunition in Louisiana waters: 1 in 2014 within Barataria Bay (Barataria Bay Stock), and 1 in 2013 in a canal off Terrebonne Bay (Terrebonne Bay, Timbalier Bay Stock). In 2013 in Mississippi Sound, a dolphin was found with a bullet lodged in its lung. Necropsy results indicated the bullet had been there for several months and likely was not the cause of death. In the gunshot cases, it is unknown whether the animals were shot due to depredation of fishing gear, but it is possible one or more of these acts was related to depredation. All of these shootings were included in the stranding database and in Table 2. During 2012 a dolphin was observed swimming in Perdido Bay with a screwdriver protruding from its melon and was found dead the next day. This stabbing was included in the stranding database and in Table 2.

Illegal feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and in and near Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells 2011), and also in Texas near Corpus Christi (Bryant 1994). Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, a high rate of provisioning was observed near Panama City Beach in 1998 (Samuels and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells 2011). There are emerging questions regarding potential linkages between provisioning and depredation of recreational fishing gear and associated entanglement and ingestion of gear, which is increasing through much of Florida. During 2006, at least 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (Powell and Wells 2011).

Swimming with wild bottlenose dolphins has also been documented in Florida in Key West (Samuels and Engleby 2007) and near Panama City Beach (Samuels and Bejder 2004). Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to illegal provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under the MMPA.

As noted previously, bottlenose dolphins are known to be struck by vessels (Wells and Scott 1997; Wells *et al.* 2008). During 2010–2014, 19 stranded bottlenose dolphins (of 564 total strandings) showed signs of a boat collision (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). It is possible some of the instances were post-mortem collisions. In addition to vessel collisions, the presence of vessels may also impact bottlenose dolphin behavior in bays, sounds and estuaries. Nowacek *et al.* (2001) reported that boats pass within 100 m of each bottlenose dolphin in Sarasota Bay once every 6 minutes on average, leading to changes in dive patterns and group cohesion. Buckstaff (2004) noted changes in communication patterns of Sarasota Bay dolphins when boats approached. Miller *et al.* (2008) investigated the immediate responses of bottlenose dolphins to "high-speed personal watercraft" (i.e., boats) in Mississippi Sound. They found an immediate impact on dolphin behavior demonstrated by an increase in traveling behavior and dive duration, and a decrease in feeding behavior for non-traveling groups. The findings suggested dolphins attempted to avoid high-speed personal watercraft. It is unclear whether repeated short-term effects will result in long-term consequences like reduced health and viability of dolphins. Further studies are needed to determine the impacts throughout the Gulf of Mexico.

As part of its annual coastal dredging program, the Army Corps of Engineers conducts sea turtle relocation trawling during hopper dredging as a protective measure for marine turtles. No interactions have been documented during the most recent 5 years, 2010–2014, that fall within BSE stocks in this report; however, 1 interaction occurred within the boundaries of the Mississippi Sound, Lake Borgne, Bay Boudreau Stock (please see that SAR for details). In earlier years, 5 interactions, including 4 mortalities (2003, 2005, 2006, 2007), were documented in the Gulf of Mexico involving bottlenose dolphins and relocation trawling activities. It is likely that 2 of these animals belonged to BSE stocks (2003, 2006).

There have been documented mortalities of common bottlenose dolphins during health-assessment research projects in the Gulf of Mexico, but none have occurred during the most recent 5 years, 2010–2014. Historically, 1 mortality occurred within Sarasota Bay in 2002, and 1 mortality occurred in St. Joseph Bay in 2006.

Some of the BSE communities were the focus of a live-capture fishery for bottlenose dolphins which supplied dolphins to the U.S. Navy and to oceanaria for research and public display for more than 2 decades (Reeves and Leatherwood 1984; Scott 1990). Between 1973 and 1988, 533 bottlenose dolphins were removed from Southeastern U.S. waters (Scott 1990). The impact of these removals on the stocks is unknown. In 1989, the Alliance of Marine Mammal Parks and Aquariums declared a self-imposed moratorium on the capture of bottlenose dolphins in the Gulf of Mexico (Corkeron 2009).

## HABITAT ISSUES

The DWH MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500 m deep, exploded on 20 April 2010. The rig sank, and over 87 days up to ~4.9 million barrels of oil were discharged from the wellhead until it was capped on 15 July 2010 (McNutt *et al.* 2012). During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns (Buist *et al.* 1999; NOAA 2011). The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011; Michel *et al.* 2013). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi's mainland coast, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana. Heavy to light oiling occurred on Mississippi's barrier islands (Michel *et al.* 2013). Thus, it is likely that some BSE stocks were exposed to oil. Dolphins were observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays. The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; Helm *et al.* 2015). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; Helm *et al.* 2015).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, continental shelf, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure relative to oil from the DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, Mississippi Sound, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

The nearshore habitat occupied by many of these stocks is adjacent to areas of high human population, and in some bays, such as Mobile Bay in Alabama and Galveston Bay in Texas, is highly industrialized. The area surrounding Galveston Bay, for example, has a coastal population of over 3 million people. More than 50% of all chemical products manufactured in the U.S. are produced there, and 17% of the oil produced in the Gulf of Mexico is refined there (Henningsen and Würsig 1991). Many of the enclosed bays in Texas are surrounded by agricultural lands which receive periodic pesticide applications.

Concentrations of chlorinated hydrocarbons and metals were examined in conjunction with an anomalous mortality event of bottlenose dolphins in Texas bays in 1990 and found to be relatively low in most; however, some had concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992). No studies to date have determined the amount, if any, of indirect human-induced mortality resulting from pollution or habitat degradation.

Analyses of organochlorine concentrations in the tissues of bottlenose dolphins in Sarasota Bay, Florida, have found that the concentrations in male dolphins exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002). 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). While there are no direct measurements of adverse effects of pollutants on estuary dolphins, the exposure to environmental pollutants and subsequent effects on population health are areas of concern and active research.

**STATUS OF STOCKS**

The status of these stocks relative to OSP is unknown and this species is not listed as threatened or endangered under the Endangered Species Act. The occurrence of 13 Unusual Mortality Events (UMEs) among common bottlenose dolphins along the northern Gulf of Mexico coast since 1990 (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/events.html, accessed 11 January 2016) is cause for concern. Notably, stock areas in Louisiana, Mississippi, Alabama and the western Florida panhandle have been impacted by a UME of unprecedented size and duration (began 1 February 2010, and as of December 2015, the event is under consideration for closure). However, the effects of the mortality events on stock abundance have not yet been determined, in large part because it has not been possible to assign mortalities to specific stocks due to a lack of empirical information on stock identification.

Human-caused mortality and serious injury for each of these stocks is not known. Considering the evidence from stranding data (Table 2) and the low PBRs for stocks with recent abundance estimates, the total fishery-related mortality and serious injury likely exceeds 10% of the total known PBR or previous PBR, and therefore, it is probably not insignificant and not approaching the zero mortality and serious injury rate. NMFS considers each of these stocks to be strategic because most of the stock sizes are currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR.

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# ROUGH-TOOTHED DOLPHIN (*Steno bredanensis*): Northern Gulf of Mexico Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

The rough-toothed dolphin is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983; Miyazaki and Perrin 1994; West *et al.* 2011). Rough-toothed dolphins occur in oceanic and to a lesser extent continental shelf waters in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) (Figure 1; Fulling *et al.* 2003; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). Rough-toothed dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). Four dolphins from a mass stranding of 62 animals in the Florida Panhandle in December 1997 were rehabilitated and released in 1998, and satellite-linked transmitters on 3 of these were tracked for 4 to 112 days. A report after 5 months indicated that the animals returned to, and remained in, northeastern Gulf waters averaging about 195 m deep offshore of the original stranding site (Wells *et al.* 1999).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), rough-toothed dolphins almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters comprise only about 40% of the entire Gulf of Mexico and 35% of the oceanic (i.e., >200 m) Gulf of Mexico. The Gulf of Mexico population is being considered 1 stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s), nor information on whether more than 1 stock may exist in the Gulf of Mexico. Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

## POPULATION SIZE

The current population size for the rough-toothed dolphin in the northern Gulf of Mexico is 624 (CV=0.99; Table 1; Garrison 2016). This estimate is from a summer 2009 oceanic survey covering waters from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ).

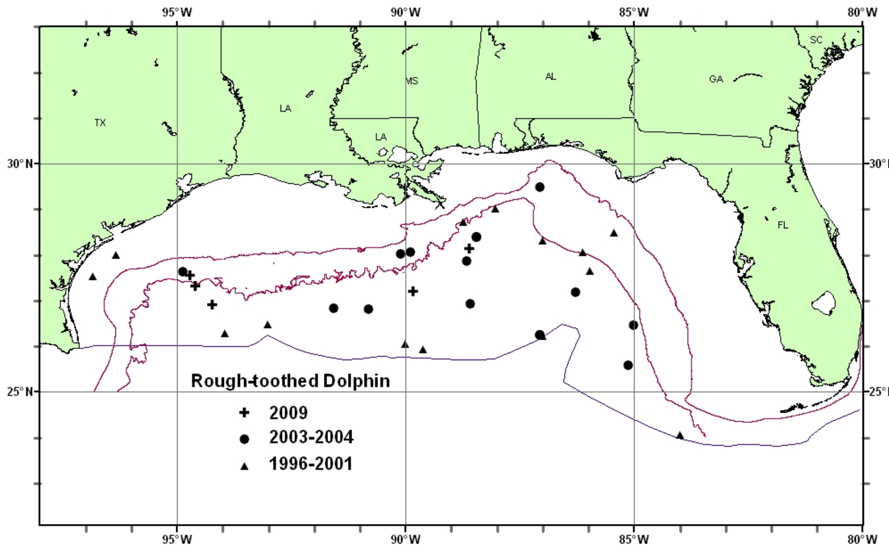


Figure 1. *Distribution of rough-toothed dolphin sightings from SEFSC vessel surveys during spring and fall 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

### Earlier abundance estimates

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to line-transect survey data. During summer 2003 and spring 2004, ship surveys dedicated to estimating cetacean abundance were conducted in oceanic waters along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for rough-toothed dolphins in oceanic waters, pooled from 2003 to 2004, was 1,508 (CV=0.39) (Mullin 2007).

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

**Recent surveys and abundance estimates**

During summer 2009, a line-transect shipboard survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico covering waters depths from the 200-m isobath to the seaward extent of the U.S. EEZ (Garrison 2016). Survey lines were stratified in relation to depth and the location of the Loop Current. In total, 4,600 km of trackline were surveyed using a single visual observation team. The abundance estimate for rough-toothed dolphins in oceanic waters during 2009 was 624 (CV=0.99; Table 1; Garrison 2016). This is the most reliable current estimate for the northern Gulf of Mexico but it is probably an underestimate. This estimate does not include Gulf of Mexico continental shelf waters where an estimate based on 1998–2001 surveys was over 1,000 rough-toothed dolphins (Fulling *et al.* 2003). There is not a recent estimate for continental shelf waters.

Table 1. Most recent abundance estimates ($N_{best}$) and coefficient of variation (CV) of rough-toothed dolphins in the northern Gulf of Mexico oceanic waters (200 m to the offshore extent of the EEZ) during spring/summer 2003–2004 and summer 2009.

| Month/Year | Area | $N_{best}$ | CV |
|---|---|---|---|
| Spring/Summer 2003–2004 | Oceanic | 1,508 | 0.39 |
| Summer 2009 | Oceanic | 624 | 0.99 |

**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 of abundance for rough-toothed dolphins is 624 (CV=0.99). The minimum population estimate for northern Gulf of Mexico rough-toothed dolphins is 311.

**Current Population Trend**

A trend analysis has not been conducted for this stock. Two point estimates of rough-toothed dolphin abundance have been made based on data from oceanic surveys during 2003–2004 and 2009 (Table 1). The estimates vary by a factor of more than two. To determine whether changes in oceanic abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. It should be noted that since this is a transboundary stock and the abundance estimates are for U.S. waters only, it will be difficult to interpret any detected trends. Additionally, the extent to which rough-toothed dolphins inhabit continental shelf waters and whether there is movement between these waters and oceanic waters needs to be resolved.

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

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

**POTENTIAL BIOLOGICAL REMOVAL**

Potential Biological Removal (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 311. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.40 because the CV of the average mortality estimate is greater than 0.8 (Wade and Angliss 1997). PBR for the northern Gulf of Mexico rough-toothed dolphin is 2.5.

**ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY**

The estimated mean annual fishery-related mortality and serious injury for this stock during 2010–2014 was 0.8 rough-toothed dolphins (CV=1.0; Table 2) due to interactions with the pelagic longline fishery.

**New Serious Injury Guidelines**

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

**Fisheries Information**

The commercial fishery that interacts, or that potentially could interact, with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the large pelagics longline fishery operating in the northern Gulf of Mexico. For the 5-year period 2010–2014, the estimated annual combined serious injury and mortality attributable to the large pelagics longline fishery in the northern Gulf of Mexico was 0.8 (CV=1.0) rough-toothed dolphins (Table 2). During the second quarter of 2014, 2 serious injuries were observed (Garrison and Stokes 2016). There were no reports of mortality or serious injury to rough-toothed dolphins by this fishery in the northern Gulf of Mexico during 1998–2013 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2012a,b; 2013; 2014; 2016).

During the second quarters (15 April – 15 June) of 2010–2014, observer coverage in the Gulf of Mexico large pelagics longline fishery was greatly enhanced (approaching 55%) to collect more robust information on the interactions between pelagic longline vessels and spawning bluefin tuna. Therefore, the high annual observer coverage rates during 2010–2014 (Table 2) primarily reflect high coverage rates during the second quarter of each year. During the second quarter, this elevated coverage results in an increased probability that relatively rare interactions will be detected. Species within the oceanic Gulf of Mexico are presumed to be resident year-round; however, it is unknown if the bycatch rate observed during the second quarter is representative of that which occurs throughout the year.

Table 2. Summary of the incidental mortality and serious injury of northern Gulf of Mexico rough-toothed dolphins in the pelagic longline commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the annual observed serious injury and mortality recorded by on-board observers, the annual estimated serious injury and mortality, the combined annual estimates of serious injury and mortality (Estimated Combined Mortality), the estimated CV of the combined annual mortality estimates (Est. CVs) and the mean of the combined mortality estimates (CV in parentheses).

| Fishery | Years | Vessels [a] | Data Type [b] | Observer Coverage [c] | Observed Serious Injury | Observed Mortality | Estimated Serious Injury | Estimated Mortality | Estimated Combined Mortality | Est. CVs | Mean Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pelagic Longline | 2010–2014 | 46, 42, 47, 47, 44 | Obs. Data Logbook | .28, .18, .11, .25, .18 | 0, 0, 0, 0, 1 | 0, 0, 0, 0, 0 | 0, 0, 0, 0, 4.2 | 0, 0, 0, 0, 0 | 0, 0, 0, 0, 4.2 | NA, NA, NA, NA, 1.00 | 0.8 (1.0) |

[a] Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.
[b] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC). Observer coverage in the GOM is dominated by very high coverage rates during April–June associated with efforts to improve estimates of bluefin tuna bycatch.
[c] Proportion of sets observed.

**Other Mortality**

There were 4 stranded rough-toothed dolphins in the northern Gulf of Mexico during 2010–2014 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). No evidence of human interaction was detected for 2 stranded animals, and for the remaining 2, it could not be determined if there was evidence of human interaction. Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al*. 2012; Wells *et al*. 2015).

Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al*. 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

An Unusual Mortality Event (UME), involving primarily bottlenose dolphins, was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010 and ending 31 July 2014 (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm, accessed 1 June 2016). Investigations to date have determined that the DWH oil spill is the primary underlying cause of the elevated stranding numbers in the northern Gulf of Mexico after the spill (e.g., Schwacke *et al.* 2014; Venn-Watson *et al.* 2015). During 2010–2014, 1 animal from this stock was considered to be part of the UME, a 2013 stranding in Destin, Florida.

## HABITAT ISSUES

The DWH MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500 m deep, exploded on 20 April 2010. The rig sank, and over 87 days up to ~4.9 million barrels of oil were discharged from the wellhead until it was capped on 15 July 2010 (McNutt *et al.* 2012). During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns (Buist *et al.* 1999; NOAA 2011). The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, continental shelf, coastal and estuarine marine mammals. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure relative to oil from the DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite-linked tags on sperm and Bryde’s whales.

Vessel and aerial surveys documented common bottlenose dolphins, Atlantic spotted dolphins, rough-toothed dolphins, spinner dolphins, pantropical spotted dolphins, Risso's dolphins, striped dolphins, sperm whales, dwarf/pygmy sperm whales and a Cuvier's beaked whale swimming in oil or potentially oil-derived substances (e.g., sheen, mousse) in offshore waters of the northern Gulf of Mexico following the DWH oil spill. The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; Helm *et al.* 2015). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal’s ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; Helm *et al.* 2015).

## STATUS OF STOCK

Rough-toothed dolphins are not listed as threatened or endangered under the Endangered Species Act, and the northern Gulf of Mexico stock is not considered strategic under the MMPA. Total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of rough-toothed dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. There are insufficient data to determine the population trends for this stock.

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

| Category, Fishery, Species | Yrs. 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 | 2010-2014 | .17, .19, .15, .11, .18 | | 387(.27), 273(.20), 277(.59), 399(.33), 128(.27) | 293(.17) | 706 |
| Atlantic white sided dolphin | 2010-2014 | .17, .19, .15, .11, .18 | 4, 1, 0, 0, 0 | 66(.9), 18(.43), 9(.92), 4(1.03), 10(.66) | 21(.57) | 304 |
| Common dolphin | 2010-2014 | .17, .19, .15, .11, .18 | | 69(.81), 49(.71), 95(.40), 104(.46), 111(.47) | 83(.24) | 557 |
| Long-finned pilot whale | 2010-2014 | .17, .19, .15, .11, .18 | | 3(.82), 0, 0, 0, 0 | 0.6(.82) | 35 |
| Risso's dolphin | 2010-2014 | .17, .19, .15, .11, .18 | | 0, 0, 6(.87), 23(1.0), 0 | 5.8 (.79) | 126 |
| Bottlenose dolphin (offshore) | 2010-2014 | .17, .19, .15, .11, .18 | | 0, 0, 0, 26(.95), 0 | 5.2(.95) | 561 |
| Harbor seal | 2010-2014 | .17, .19, .15, .11, .18 | | 540(.25), 343(.19), 252(.26), 142(.31), 390(.39) | 334 (.14) | 2,006 |
| Gray seal | 2010-2014 | .17, .19, .15, .11, .18 | | 1155(.28), 1550(.22), 542(.19), 1127(.20), 917(.14) | 1046(.10) | unk |
| Harp seal | 2007-2011 | .07, .05, .04, .17, .19 | | 238(.38), 415(.27), 253(.61), 14(.46) | 208(.21) | unk |
| **Gillnet Fisheries:US Mid-Atlantic gillnet** | | | | | | |
| Harbor porpoise | 2010-2014 | .04, .02, .02, .03, .05 | | 259(.88), 123(.41), 63(.83), 19(1.06), 22(1.03) | 97(.05) | 706 |
| Common dolphin | 2010-2014 | .04, .02, .02, .03, .05 | | 30(.48), 29(.53), 15(.93), 62(.67), 17(.86) | 31(.33) | 557 |
| Harbor seal | 2010-2014 | .04, .02, .02, .03, .05 | | 89(.39), 21(.67), 0, 0, 19(1.06) | 26(.33) | 2,006 |
| Harp Seal | 2007-2011 | .05, .03, .03, .04, .02 | | 176(.74), 70(.67), 32(.93), 0 | 63(.46) | unk |
| Gray Seal | 2010-2014 | .04, .02, .02, .03, .05 | | 267(.75), 19(.60), 14(98), 0, 22(1.09) | 64(.63) | unk |
| **Longline Fisheries: Pelagic longline (excluding NED-E)** | | | | | | |
| Risso's dolphin | 2010-2014 | .08, .09, .07, .09, .10 | 0, 12(.63), 15 (1.0), 1.9(1.0), 7.7(1.0) | 0, 0, 0, 0, 0 | 7.3(.52) | 126 |
| Short-finned pilot whale | 2010-2014 | .08, .09, .07, .09, .10 | 127(.78), 286 (.29), 170(.33), 124(.32), 233(.24) | 0, 19, 0, 0, 0 | 192 (.17) | 159 |
| Long-finned pilot whale | 2010-2014 | 08, .09, .07, .09, .10 | 0, 0, 0, 0, 9.6 | 0, 0, 0, 0, 0 | 1.9(.43) | 35 |
| Bottlenose dolphin (offshore) | 2010-2014 | .08, .09, .07, .09, .10 | 0,0, 61.8(.68), 0,0 | 0, 0, 0, 0, 0 | 12.4(.68) | 561 |
| Kogia spp. | 2010-2014 | .08, .09, .07, .09, .10 | 0, 17, 0, 0, 0 | 0, 0, 0, 0, 0 | 3.5(1.0) | 21 |
| | | | | | | |
| | | | | | | |

| Category, Fishery, Species | Yrs. observed | observer coverage | Est. SI by Year (CV) | Est. Mortality by Year (CV) | Mean Annual Mortality | PBR |
|---|---|---|---|---|---|---|
| **CATEGORY II** | | | | | | |
| **Mid-Atlantic Mid-Water Trawl – Including Pair Trawl** | | | | | | |
| Gray Seal | 2010-2014 | .25, .41, .21, .07, .05 | | na, 0, 0, 0, 0 | 0.2(na) | unk |
| Harbor Seal | 2010-2014 | .25, .41, .21, .07, .05 | | na, 0, 0, 0, 0 | 0.2(na) | 2,006 |
| **Trawl Fisheries:Northeast bottom trawl** | | | | | | |
| Harp seal | 2007-2011 | .06, .08, .09, .16, .26 | | unk, 0, 0, 0, unk | unk | unk |
| Harbor seal | 2010-2014 | .16, .26, .17, .15, .17 | 0, 0, 0, 0, 0 | 0, 9(.58), 3(1), 4(.96), 11(.63) | 4(.44) | 2,006 |
| Gray seal | 2010-2014 | .16, .26, .17, .15, .17 | | 30(.34), 58(.25), 37(.49), 30(.37), 19(.45) | 33(.17) | unk |
| Risso's dolphin | 2010-2014 | .16, .26, .17, .15, .17 | | 2(.55), 3(.55), 0, 0, 4.2(.91) | 1.8 (.47) | 126 |
| Bottlenose dolphin (offshore) | 2010-2014 | .16, .26, .17, .15, .17 | 0, 0, 0, 0, 0 | 4(.53),10(.84), 0, 0, 0 | 2.8(.62) | 561 |
| Long-finned pilot whale | 2010-2014 | .16, .26, .17, .15, .17 | 6, 12, 10, 0, 6, | 30 (43), 55(.18), 33(.32), 16(.42), 25(.44) | 33(.15) | 35 |
| Common dolphin | 2010-2014 | .16, .26, .17, .15, .17 | 3, 2, 0, 0, 0 | 111(.32), 70(.37), 40(.54), 17(.54), 17(.53) | 52 (.2) | 557 |
| Atlantic white-sided dolphin | 2010-2014 | .16, .26, .17, .15, .17 | 1, 3, 0, 0, 0 | 36(.32), 138(.24), 27(.47), 33(.31), 16(.5) | 51(.16) | 304 |
| Harbor porpoise | 2010-2014 | .16, .26, .17, .15, .17 | 0, 2, 0, 0, 0 | 0, 0, 3.9(.71), 0, 7(.98), 5.5(.86) | 3.7(.51) | 706 |
| **Mid-Atlantic Bottom Trawl** | | | | | | |
| Common dolphin | 2010-2014 | .06, .08, .05, .06, .08 | 1, 8, 7, 0, 0 | 20(.96), 263(.25), 316(.26), 269(.29), 329(.29) | 243 (.14) | 57 |
| Atlantic white-sided dolphin | 2010-2014 | .06, .08, .05, .06, .08 | 0, 0, 0, 0, 0 | 0, 0, 0, 0, 9.7(.94) | 1.9(.94) | 304 |
| Risso's dolphin | 2010-2014 | .06, .08, .05, .06, .08 | | 54(.74), 62(.56), 7(1.0), 46(.71), 21(.93) | 38 (.35) | 126 |
| Bottlenose dolphin (offshore) | 2010-2014 | .06, .08, .05, .06, .08 | 0, 0, 0, 0, 0 | 20(.34),34(.31), 16(1.0), 0, 25(.66) | 19(.28) | 561 |
| Harbor seal | 2010-2014 | .06, .08, .05, .06, .08 | 0, 0, 0, 0, 0 | 11(1.1), 0, 23(1), 11(.96), 10(.95) | 11(0.62) | 2,006 |
| Gray seal | 2010-2014 | .06, .08, .05, .06, .08 | 0, 0, 0, 0, 0 | 0, 25(.57) 30(1.1), 29(.67), 7(.96) | 18(.45) | unk |
| **Northeast Mid-Water Trawl Including Pair Trawl** | | | | | | |
| Long -finned pilot whale | 2010-2014 | .41, .17, .45, .37, .42 | 0, 0, 0, 0, 0 | 0, 1, 1, 3, 4 | 1.8(na) | 35 |
| Common dolphin | 2010-2014 | .41, .17, .45, .37, .42 | 0, 0, 0, 0, 0 | 1, 0, 1, 0, 0 | 0.4(na) | 557 |
| Harbor seal | 2010-2014 | .41, .17, .45, .37, .42 | 0, 0, 0, 0, 0 | na, 0, na, 0, na | 0.8(na) | 2,006 |
| Gray seal | 2010-2014 | .41, .17, .45, .37, .42 | 0, 0, 0, 0, 0 | 0, 0, na, na, 0 | 0.4(na) | unk |
| Minke whale | 2010-2014 | .41, .17, .45, .37, .42 | 0, 0, 0, 0, 0 | 0, 0, 0, na, 0 | 0.2(na) | 14 |

Appendix II. Summary of the confirmed anecdotal human-caused mortality and serious injury (SI) events involving baleen whale stocks along the Gulf of Mexico Coast, US East Coast, and adjacent Canadian Maritimes, 2010–2014, with number of events attributed to entanglements or vessel collisions by year.

| Stock | Mean annual mortality and SI rate (PBR[1] for reference) | Entanglements | | | Vessel Collisions | | |
|---|---|---|---|---|---|---|---|
| | | Annual rate (US waters / Canadian waters/unknown first sighted in US/unknown first sighted in Canada) | Confirmed mortalities (2010, 2011, 2012, 2013, 2014) | Confirmed SIs (2010, 2011, 2012, 2013, 2014) | Annual rate (US waters / Canadian waters/unknown first sighted in US/unknown first sighted in Canada) | Confirmed mortalities (2010, 2011, 2012, 2013, 2014) | Confirmed SIs (2010, 2011, 2012, 2013, 2014) |
| Western North Atlantic right whale *(Eubalaena glacialis)* | 5.66 (1) | 4.65 ( 0.40/ 0.00/ 2.5/ 1.75) | (3, 1, 2, 0, 2) | (1, 5, 2, 1, 7) | 1.01 ( 0.81/ 0.00/ 0.20/ 0.00) | (1, 1, 0, 0, 0) | (0, 2, 1, 0, 0) |
| Gulf of Maine humpback whale *(Megaptera novaeangliae)* | 9.05 (13) | 7.25 (1.8/ 035/ 4.55/ 0.70) | (4, 0, 0, 2, 2) | (8, 9, 5, 2, 3) | 1.8 ( 1.40/ 0.00/ 0.00/ 0.00) | (3, 3, 0, 2, 1) | 0 |
| Western North Atlantic fin whale *(Balaenoptera physalus)* | 3.8 (2.5) | 1.8 ( 0.20/ 0.80/ 0.8/ 0) | (0, 3, 0, 0, 1) | (0, 1, 2, 1, 0) | 2.0 ( 2.00/ 0.00/ 0.00/ 0.00) | (2, 1, 4, 1, 2) | 0 |
| Nova Scotian sei whale *(B. borealis)* | 0.8 (0.5) | 0 | 0 | 0 | 0.8 ( 0.80/ 0.00/ 0.00/ 0.00) | (0, 1, 0, 0, 3) | 0 |
| Canadian East Coast minke whale *(B. acutorostrata)* | 8.25 (14) | 6.65 ( 1.90/ 2.5/ 2.25/ 0.00) | (2, 4, 6, 1, 3) | (2, 5, 7, 3, 1) | 1.6 ( 1.2/ 0.4/ 0.00/ 0.00) | (1, 3, 1, 0, 3) | 0 |

[1] Potential Biological Removal (PBR)

[2] Stock abundance estimates outdated; no PBR established for this stock.

## Appendix III
## Fishery Descriptions

This appendix is broken into two parts: Part A describes commercial fisheries that have documented interactions with marine mammals in the Atlantic Ocean; and Part B describes commercial fisheries that have documented interactions with marine mammals in the Gulf of Mexico. A complete list of all known fisheries for both oceanic regions, the List of Fisheries, is published in the *Federal Register* annually. Each part of this appendix contains three sections: I. data sources used to document marine mammal mortality/entanglements and commercial fishing effort trip locations, II. links to fishery descriptions for Category I, II and some category III fisheries that have documented interactions with marine mammals and their historical level of observer coverage, and III. historical fishery descriptions.

### Part A. Description of U.S Atlantic Commercial Fisheries

#### I. Data Sources

Items 1-5 describe sources of marine mammal mortality, serious injury or entanglement data; items 6-9 describe the sources of commercial fishing effort data used to summarize different components of each fishery (i.e. active number of permit holders, total effort, temporal and spatial distribution) and generate maps depicting the location and amount of fishing effort.

**1. Northeast Region Fisheries Observer Program (NEFOP)**

In 1989 a Fisheries Observer Program was implemented in the Northeast Region (Maine-Rhode Island) to document incidental bycatch of marine mammals in the Northeast Region Multi-species Gillnet Fishery. In 1993 sampling was expanded to observe bycatch of marine mammals in Gillnet Fisheries in the Mid-Atlantic Region (New York-North Carolina). The Northeast Fisheries Observer Program (NEFOP) has since been expanded to sample multiple gear types in both the Northeast and Mid-Atlantic Regions for documenting and monitoring interactions of marine mammals, sea turtles and finfish bycatch attributed to commercial fishing operations. At sea observers onboard commercial fishing vessels collect data on fishing operations, gear and vessel characteristics, kept and discarded catch composition, bycatch of protected species, animal biology, and habitat (NMFS-NEFSC 2003).

**2. Southeast Region Fishery Observer Programs**

Three Fishery Observer Programs are managed by the Southeast Fisheries Science Center (SEFSC) that observe commercial fishery activity in U.S. Atlantic waters. The Pelagic Longline Observer Program (POP) administers a mandatory observer program for the U.S. Atlantic Large Pelagics Longline Fishery. The program has been in place since 1992 and randomly allocates observer effort by eleven geographic fishing areas proportional to total reported effort in each area and quarter. Observer coverage levels are mandated under the Highly Migratory Species Fisheries Management Plan (HMS FMP, 50 CFR Part 635). The second program is the Shark Gillnet Observer Program that observes the Southeastern U.S. Atlantic Shark Gillnet Fishery. The Observer Program is mandated under the HMS FMP, the Atlantic Large Whale Take Reduction Plan (ALWTRP) (50 CFR Part 229.32), and the Biological Opinion under Section 7 of the Endangered Species Act. Observers are deployed on any active fishing vessel reporting shark drift gillnet effort. In 2005, this program also began to observe sink gillnet fishing for sharks along the southeastern U.S. coast. The observed fleet includes vessels with an active directed shark permit and fish with sink gillnet gear (Carlson and Bethea 2007). The third program is the Southeastern Shrimp Otter Trawl Fishery Observer Program. Prior to 2007, this was a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program was funding and project dependent, therefore observer coverage is not necessarily randomly allocated across the fishery. In 2007, the observer program was expanded, and it became mandatory for fishing vessels to take an observer if selected. The program now includes more systematic sampling of the fleet based upon reported landings and effort patterns. The total level of observer coverage for this program is approximately 1% of the total fishery effort. In each Observer Program, the observers record information on the total target species catch, the number and type of interactions with protected species (including both marine mammals and sea turtles), and biological information on species caught.

**3. Regional Marine Mammal Stranding Networks**

The Northeast and Southeast Region Stranding Networks are components of the Marine Mammal Health and Stranding Response Program (MMHSRP). The goals of the MMHSRP are to facilitate collection and dissemination of data, assess health trends in marine mammals, correlate health with other biological and environmental parameters, and coordinate effective responses to unusual mortality events (Becker *et al.* 1994). Since 1997, the Northeast Region Marine Mammal Stranding Network has been collecting and storing data on marine mammal strandings and entanglements that occur from Maine through Virginia. The Southeast Region Strandings Program is responsible for data collection and stranding response coordination along the Atlantic coast from North Carolina to Florida, along the U.S. Gulf of Mexico coast from Florida through Texas, and in the U.S. Virgin Islands and Puerto Rico. Prior to 1997, stranding and entanglement data were maintained by the New England Aquarium and the National Museum of Natural History, Washington, D.C. Volunteer participants, acting under a letter of agreement, collect data on stranded animals that include: species; event date and location; details of the event (i.e., signs of human interaction) and determination on cause of death; animal disposition; morphology; and biological samples. Collected data are reported to the appropriate Regional Stranding Network Coordinator and are maintained in regional and national databases.

**4. Marine Mammal Authorization Program**

Commercial fishing vessels engaging in Category I or II fisheries are automatically registered under the Marine Mammal Authorization Program (MMAP) in order to lawfully take a non-endangered/threatened marine mammal incidental to fishing operations. These fishermen are required to carry an Authorization Certificate onboard while participating in the listed fishery, must be prepared to carry a fisheries observer if selected, and must comply with all applicable take reduction plan regulations. All vessel owners, regardless of the category of fishery they are operating in, are required to report, within 48 hours of the incident and even if an observer has recorded the take, all incidental injuries and mortalities of marine mammals that have occurred as a result of fishing operations (NMFS-OPR 2003). Events are reported by fishermen on the Marine Mammal Mortality/Injury forms then submitted to and maintained by the NMFS Office of Protected Resources. The data reported include: captain and vessel demographics; gear type and target species; date, time and location of event; type of interaction; animal species; mortality or injury code; and number of interactions. Reporting forms are available online at http://www.nmfs.noaa.gov/pr/pdfs/interactions/mmap_reporting_form.pdf.

**5. Other Data Sources for Protected Species Interactions/Entanglements/Ship Strikes**

In addition to the above, data on fishery interactions/entanglements and vessel collisions with large cetaceans are reported from a variety of other sources including the New England Aquarium (Boston, Massachusetts); Provincetown Center for Coastal Studies (Provincetown, Massachusetts); U.S. Coast Guard; whale watch vessels; Canadian Department of Fisheries and Oceans (DFO)); and members of the Atlantic Large Whale Disentanglement Network. These data, photographs, etc. are maintained by the Protected Species Division at the Greater Atlantic Regional Fisheries Office (GARFO), the Protected Species Branch at the Northeast Fisheries Science Center (NEFSC) and the Southeast Fisheries Science Center (SEFSC).

**6. Northeast Region Vessel Trip Reports**

The Northeast Region Vessel Trip Report Data Collection System is a mandatory, but self-reported, commercial fishing effort database (Wigley *et al.* 1998). The data collected include: species kept and discarded; gear types used; trip location; trip departure and landing dates; port; and vessel and gear characteristics. The reporting of these data is mandatory only for vessels fishing under a federal permit. Vessels fishing under a federal permit are required to report in the Vessel Trip Report even when they are fishing within state waters.

**7. Southeast Region Fisheries Logbook System**

The Fisheries Logbook System (FLS) is maintained at the SEFSC and manages data submitted from mandatory Fishing Vessel Logbook Programs under several FMPs. In 1986 a comprehensive logbook program was initiated for the Large Pelagics Longline Fishery and this reporting became mandatory in 1992. Logbook reporting has also been initiated since the 1990s for a number of other fisheries including: Reef Fish Fisheries; Snapper-Grouper Complex Fisheries; federally managed Shark Fisheries; and King and Spanish Mackerel Fisheries. In each case, vessel captains are required to submit information on the fishing location, the amount and type of fishing gear used, the total amount of fishing effort (e.g., gear sets) during a given trip, the total weight and composition of the catch, and the disposition of the catch during each unit of effort (e.g., kept, released alive, released dead). FLS data are used to estimate the total amount of fishing effort in the fishery and thus expand bycatch rate estimates from observer data to estimates of the total incidental take of marine mammal species in a given fishery. More information is available at http://www.sefsc.noaa.gov/fisheries/logbook.htm.

**8. Northeast Region Dealer Reported Data**
The Northeast Region Dealer Database houses trip level fishery statistics on fish species landed by market category, vessel ID, permit number, port location and date of landing, and gear type utilized. The data are collected by both federally permitted seafood dealers and NMFS port agents. Data are considered to represent a census of both vessels actively fishing with a federal permit and total fish landings. It also includes vessels that fish with a state permit (excluding the state of North Carolina) that land a federally managed species. Some states submit the same trip level data to the Northeast Region, but contrary to the data submitted by federally permitted seafood dealers, the trip level data reported by individual states does not include unique vessel and permit information. Therefore, the estimated number of active permit holders reported within this appendix should be considered a minimum estimate. It is important to note that dealers were previously required to report weekly in a dealer call in system. However, in recent years the NER regional dealer reporting system has instituted a daily electronic reporting system. Although the initial reports generated from this new system did experience some initial reporting problems, these problems have been addressed and the new daily electronic reporting system is providing better real time information to managers.

**9. Northeast At Sea Monitoring Program**
At-sea monitors collect scientific, management, compliance, and other fisheries data onboard commercial fishing vessels through interviews of vessel captains and crew, observations of fishing operations, photographing catch, and measurements of selected portions of the catch and fishing gear. At-sea monitoring requirements are detailed under Amendment 16 to the NE Multispecies Fishery Management Plan with a planned implementation date of May 1st, 2010. At-sea monitoring coverage is an integral part of catch monitoring to ensure that Annual Catch Limits are not exceeded. At-sea monitors collect accurate information on catch composition and the data are used to estimate total discards by sectors (and common pool), gear type, and stock area. Coverage levels are expected around 30%.

**II. Marine Mammal Protection Act's List of Fisheries**

The List of Fisheries (LOF) classifies U.S. commercial fisheries into one of three Categories according to the level of incidental mortality or serious injury of marine mammals:

I. frequent incidental mortality or serious injury of marine mammals
II. occasional incidental mortality or serious injury of marine mammals
III. remote likelihood of/no known incidental mortality or serious injury of marine mammals

The Marine Mammal Protection Act (MMPA) mandates that each fishery be classified by the level of mortality or serious injury and mortality of marine mammals that occurs incidental to each fishery as reported in the annual Marine Mammal Stock Assessment Reports for each stock. A fishery may qualify as one Category for one marine mammal stock and another Category for a different marine mammal stock. A fishery is typically categorized on the LOF according to its highest level of classification (e.g., a fishery that qualifies for Category III for one marine mammal stock and Category II for another marine mammal stock will be listed under Category II). The fisheries listed below are linked to classification based on the most current LOF published in the *Federal Register*.

**III. U.S Atlantic Commercial Fisheries**

Northeast Sink Gillnet:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ne_sink_gillnet.html
Northeast Anchored Float Gillnet Fishery:
http://www.nmfs.noaa.gov/pr/pdfs/fisheries/lof2012/northeast_anchored_float_gillnet.pdf
Northeast Drift Gillnet Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ne_dgn.htmlMid-Atlantic Gillnet:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/midatl_gillnet.html
Mid-Atlantic Bottom Trawl:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ma_bottom_trawl.htmlNortheast Bottom Trawl:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ne_bottom_trawl.htmlNortheast Mid-Water Trawl Fishery (includes pair trawls): http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ne_mw_trawl.html
Mid-Atlantic Mid-Water Trawl Fishery (includes pair trawls):
http://www.nmfs.noaa.gov/pr/pdfs/fisheries/lof2014/mid-atlantic-mid-water-trawl.pdf

Bay of Fundy Herring Weir
Gulf of Maine Atlantic Herring Purse Seine Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/GME_Atlantic_herring_purse_seine.html
Northeast/Mid-Atlantic American Lobster Trap/Pot:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ne_ma_lobster_trap_pot.html
Atlantic Mixed Species Trap/Pot Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/atl_mixed_trap_pot.htmlAtlantic Ocean, Caribbean, Gulf of Mexico Large Pelagics Longline:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ao_car_gmx_pelagics_longline.html
Southeast Atlantic Gillnet:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/se_atl_gn.htmlSoutheastern U.S. Atlantic Shark Gillnet Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/se_shark_gn.html
Atlantic Blue Crab Trap/Pot:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/se_bluecrab_trap_pot.htmlMid-Atlantic Haul/Beach Seine:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ma_haul_beachseine.html
North Carolina Inshore Gillnet Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/nc_inshore_gn.htmlNorth Carolina Long Haul Seine”
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/nc_longhaulseine.html
North Carolina Roe Mullet Stop Net:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/nc_roemullet_stopnet.htmlVirginia Pound Net:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/va_poundnet.htmlMid-Atlantic Menhaden Purse Seine:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ma_men_purse_seine.htmlSoutheastern U.S. Atlantic/Gulf of Mexico Shrimp Trawl:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/segom_shrimp_trawl.html
Southeastern U.S. Atlantic, Gulf of Mexico Stone Crab Trap/Pot Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/segom_stonecrab_trap_pot.html

## IV. Historical Fishery Descriptions

### Atlantic Foreign Mackerel

Prior to 1977, there was no documentation of marine mammal bycatch in DWF activities off the Northeast coast of the U.S. With implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA) in that year, an Observer Program was established which recorded fishery data and information on incidental bycatch of marine mammals. DWF effort in the U.S. Atlantic Exclusive Economic Zone (EEZ) under MFCMA had been directed primarily towards Atlantic Mackerel and Squid. From 1977 through 1982, an average mean of 120 different foreign vessels per year (range 102-161) operated within the U.S. Atlantic EEZ. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese Tuna longline vessels operating along the U.S. east coast. This was the first year that the Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels. Between 1983 and 1991, the numbers of foreign vessels operating within the U.S. Atlantic EEZ each year were 67, 52, 62, 33, 27, 26, 14, 13, and 9 respectively. Between 1983 and 1988, the numbers of DWF vessels included 3, 5, 7, 6, 8, and 8 respectively, Japanese longline vessels. Observer coverage on DWF vessels was 25-35% during 1977-1982, and increased to 58%, 86%, 95% and 98%, respectively, in 1983-1986. One hundred percent observer coverage was maintained during 1987-1991. Foreign fishing operations for Squid ceased at the end of the 1986 fishing season and for Mackerel at the end of the 1991 season. Documented interactions with white sided dolphins were reported in this fishery.

### Pelagic Drift Gillnet

In 1996 and 1997, NMFS issued management regulations which prohibited the operation of this fishery in 1997. The fishery operated during 1998. Then, in January 1999 NMFS issued a Final Rule to prohibit the use of drift net gear in the North Atlantic Swordfish Fishery (50 CFR Part 630). In 1986, NMFS established a mandatory self-reported fisheries information system for Large Pelagic Fisheries. Data files are maintained at the SEFSC. The estimated total number of hauls in the Atlantic Pelagic Drift Gillnet Fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls from 1991 to 1996 was 233, 243, 232, 197, 164, and 149 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994 to 1998 there were 11, 12, 10, 0, and 11 vessels, respectively, in the fishery. Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, 64% in 1996, no fishery in 1997, and 99% coverage during 1998. Observer coverage dropped during 1996 because some vessels were deemed too small or unsafe by the contractor that provided observer coverage to NMFS. Fishing effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras, North Carolina. Examination of the species composition of the catch and locations of the fishery throughout the year suggest that the Drift Gillnet Fishery was stratified into two strata: a southern, or winter, stratum and a northern, or summer, stratum. Documented interactions with North Atlantic right whales, humpback whales, sperm whales, pilot whale spp., Mesoplodon spp., Risso's dolphins, common dolphins, striped dolphins and white sided dolphins were reported in this fishery.

### Atlantic Tuna Purse Seine

The Tuna Purse Seine Fishery occurring between the Gulf of Maine and Cape Hatteras, North Carolina is directed at large medium and giant Bluefin Tuna (BFT). Spotter aircraft are typically used to locate fish schools. The official start date, set by regulation, is 15 July of each year. Individual Vessel Quotas (IVQs) and a limited access system prevent a derby fishery situation. Catch rates for large medium and giant Tuna can be high and consequently, the season can last only a few weeks, however, over the last number of years, effort expended by this sector of the BFT fishery has diminished dramatically due to the unavailability of BFT on the fishing grounds.

The regulations allocate approximately 18.6% of the U.S. BFT quota to this sector of the fishery (5 IVQs) with a tolerance limit established for large medium BFT (15% by weight of the total amount of giant BFT landed.

Limited observer data is available for the Atlantic Tuna Purse Seine Fishery. Out of 45 total trips made in 1996, 43 trips (95.6%) were observed. Forty-four sets were made on the 43 observed trips and all sets were observed. A total of 136 days were covered. No trips were observed during 1997 through 1999. Two trips (seven hauls) were observed in October 2000 in the Great South Channel Region. Four trips were observed in September 2001. No marine mammals were observed taken during these trips. Documented interactions with pilot whale spp. were reported in this fishery.

### Atlantic Tuna Pelagic Pair Trawl

The Pelagic Pair Trawl Fishery operated as an experimental fishery from 1991 to 1995, with an estimated 171 hauls in 1991, 536 in 1992, 586 in 1993, 407 in 1994, and 440 in 1995. This fishery ceased operations in 1996 when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in the Atlantic Tuna Fishery. The fishery operated from August to November in 1991, from June to November in 1992, from June to October in 1993 (Northridge 1996), and from mid-summer to December in 1994 and 1995. Sea sampling began in October of 1992 (Gerrior *et al.* 1994) where 48 sets (9% of the total) were sampled. In 1993, 102 hauls (17% of the total) were sampled. In 1994 and 1995, 52% (212) and 55% (238), respectively, of the sets were observed. Nineteen vessels have operated in this fishery. The fishery operated in the area between 35N to 41N and 69W to 72W. Approximately 50% of the total effort was within a one degree square at 39N, 72W, around Hudson Canyon, from 1991 to 1993. Examination of the 1991-1993 locations and species composition of the bycatch, showed little seasonal change for the six months of operation and did not warrant any seasonal or areal stratification of this fishery (Northridge 1996). During the 1994 and 1995 Experimental Pelagic Pair Trawl Fishing Seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudy 1995, 1996), but the results were inconclusive. Documented interactions with pilot whale spp., Risso's dolphin and common dolphins were reported in this fishery.

## Part B. Description of U.S. Gulf of Mexico Fisheries

### I. Data Sources

Items 1 and 2 describe sources of marine mammal mortality, serious injury or entanglement data, and item 3 describes the source of commercial fishing effort data used to generate maps depicting the location and amount of fishing effort and the numbers of active permit holders. In general, commercial fisheries in the Gulf of Mexico have had little directed observer coverage and the level of fishing effort for most fisheries that may interact with marine mammals is either not reported or highly uncertain.

**1. Southeast Region Fishery Observer Programs**

Two fishery observer programs are managed by the SEFSC that observe commercial fishery activity in the U.S. Gulf of Mexico. The Pelagic Longline Observer Program (POP) administers a mandatory observer program for the U.S. Atlantic Large Pelagics Longline Fishery. The program has been in place since 1992, and randomly allocates observer effort by eleven geographic fishing areas proportional to total reported effort in each area and quarter. Observer coverage levels are mandated under the Highly Migratory Species FMP (HMS FMP, 50 CFR Part 635). The second is the Southeastern Shrimp Otter Trawl Fishery Observer Program. Prior to 2007, this was a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program was funding and project dependent, therefore observer coverage is not necessarily randomly allocated across the fishery. In 2007, the observer program was expanded, and it became mandatory for fishing vessels to take an observer if selected. The program now includes more systematic sampling of the fleet based upon reported landings and effort patterns. The total level of observer coverage for this program is ~ 1% of the total fishery effort. In each Observer Program, the observers record information on the total target species catch, the number and type of interactions with protected species (including both marine mammals and sea turtles), and biological information on species caught. In each Observer Program, the observers record information on the total target species catch, the number and type of interactions with protected species including both marine mammals and sea turtles, and biological information on species caught.

**2. Regional Marine Mammal Stranding Networks**

The Southeast Regional Stranding Network is a component of the Marine Mammal Health and Stranding Response Program (MMHSRP). The goals of the MMHSRP are to facilitate collection and dissemination of data, assess health trends in marine mammals, correlate health with other biological and environmental parameters, and coordinate effective responses to unusual mortality events (Becker *et al.* 1994). The Southeast Region Strandings Program is responsible for data collection and stranding response coordination along the U.S. Gulf of Mexico coast from Florida through Texas. Prior to 1997, stranding and entanglement data were maintained by the New England Aquarium and the National Museum of Natural History, Washington, D.C. Volunteer participants, acting under a letter of agreement with NOAA Fisheries, collect data on stranded animals that include: species; event date and location; details of the event including evidence of human interactions; determinations of the cause of death; animal disposition; morphology; and biological samples. Collected data are reported to the appropriate Regional Stranding Network Coordinator and are maintained in regional and national databases.

**3. Southeast Region Fisheries Logbook System**

The FLS is maintained at the SEFSC and manages data submitted from mandatory fishing vessel logbook programs under several FMPs. In 1986, a comprehensive logbook program was initiated for the Large Pelagics Longline Fisheries, and this reporting became mandatory in 1992. Logbook reporting has also been initiated since the early 1990s for a number of other fisheries including: reef fish fisheries; snapper-grouper complex fisheries; federally managed shark fisheries; and king and Spanish mackerel fisheries. In each case, vessel captains are required to submit information on the fishing location, the amount and type of fishing gear used, the total amount of fishing effort (e.g., gear sets) during a given trip, the total weight and composition of the catch, and the disposition of the catch during each unit of effort (e.g., kept, released alive, released dead). FLS data are used to estimate the total amount of fishing effort in the fishery and thus expand bycatch rate estimates from observer data to estimates of the total incidental take of marine mammal species in a given fishery.

**4. Marine Mammal Authorization Program**

Commercial fishing vessels engaging in Category I or II fisheries are automatically registered under the Marine Mammal Authorization Program (MMAP) in order to lawfully take a non-endangered/threatened marine mammal incidental to fishing operations. These fishermen are required to carry an Authorization Certificate onboard while participating in the listed fishery, must be prepared to carry a fisheries observer if selected, and must comply with all applicable take reduction plan regulations.. All vessel owners, regardless of the category of fishery they are operating in, are required to report, within 48 hours of the incident even if an observer has recorded the take, all incidental injuries and mortalities of marine mammals that have occurred as a result of fishing operations (NMFS-OPR 2003). Events are reported by fishermen on the Marine Mammal Mortality/Injury forms then submitted to and maintained by the NMFS Office of Protected Resources. The data reported include: captain and vessel demographics; gear type and target species; date, time and location of event; type of interaction; animal species; mortality or injury code; and number of interactions. Reporting forms are available online at http://www.nmfs.noaa.gov/pr/pdfs/interactions/mmap_reporting_form.pdf.

**II. Gulf of Mexico Commercial Fisheries**

Spiny Lobster Trap/Pot Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/FL_spiny_lobster_trap_pot.html
Southeastern U.S. Atlantic, Gulf of Mexico Stone Crab Trap/Pot Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/segom_stonecrab_trap_pot.htmlGulf of Mexico Menhaden Purse Seine Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/gom_men_purseseine.htmlGulf of Mexico Gillnet Fishery:
http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/gom_gn.html

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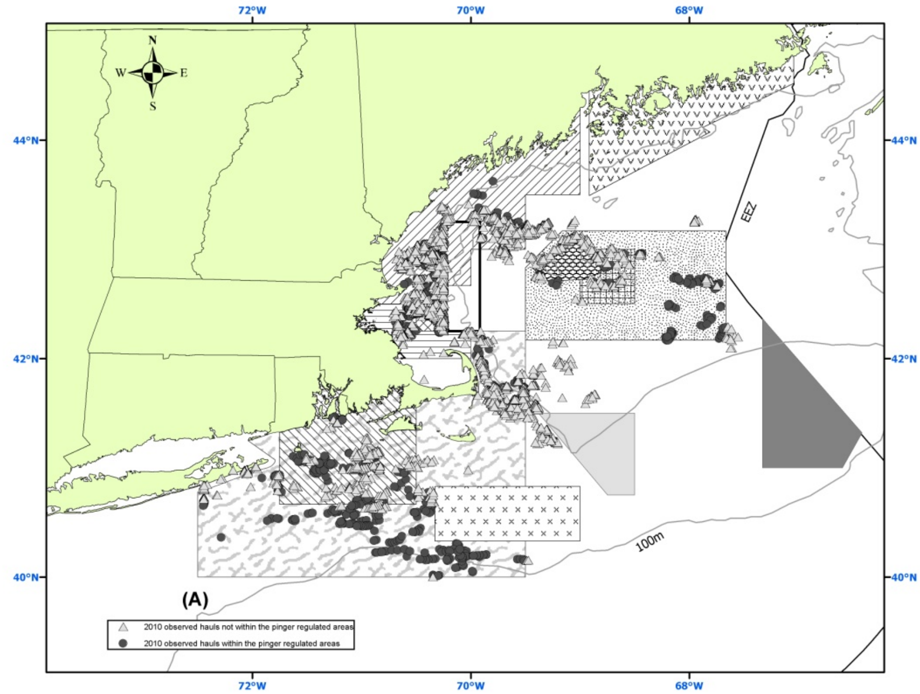
http://www.nmfs.noaa.gov/prot_res/PR2/Fisheries_Interactions/MMAP.html.
accessed on 11/05/2003

Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna driftnet and pair trawl fisheries. NMFS. 40ENNF500160 21 pp.

Wigley, S., M. Terceiro, A. Delong and K. Sosebee. 1998. Proration of 1994-96 USA Commercial Landings of Atlantic Cod, Haddock and Yellowtail Flounder to Unit Stock Areas. Northeast Fish. Sci. Cent. Ref. Doc. 98-02.

# Appendix III: Fishery Descriptions - List of Figures

Figure 1. 2010 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 Closure

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure

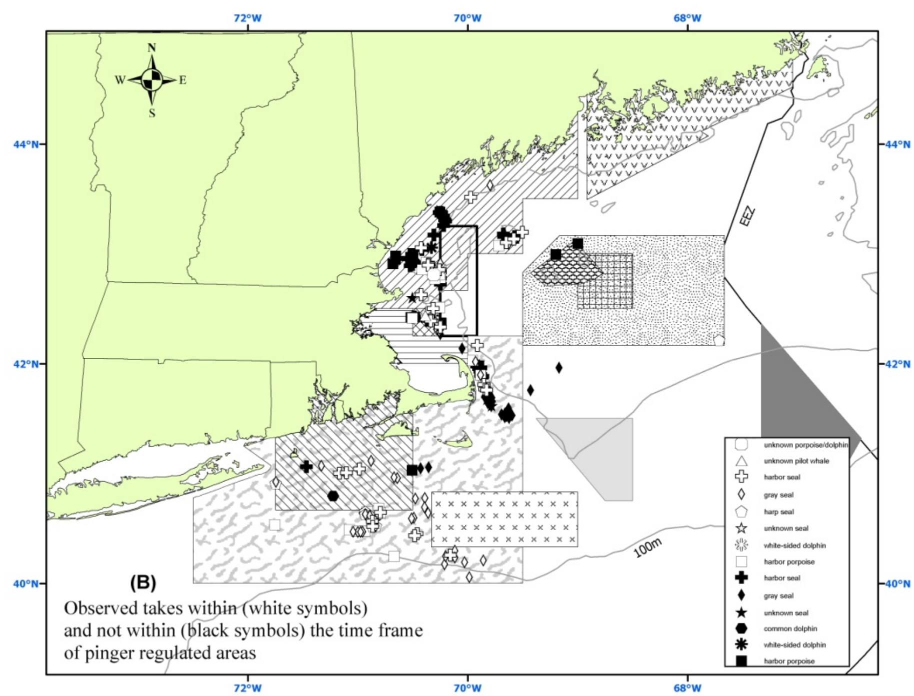
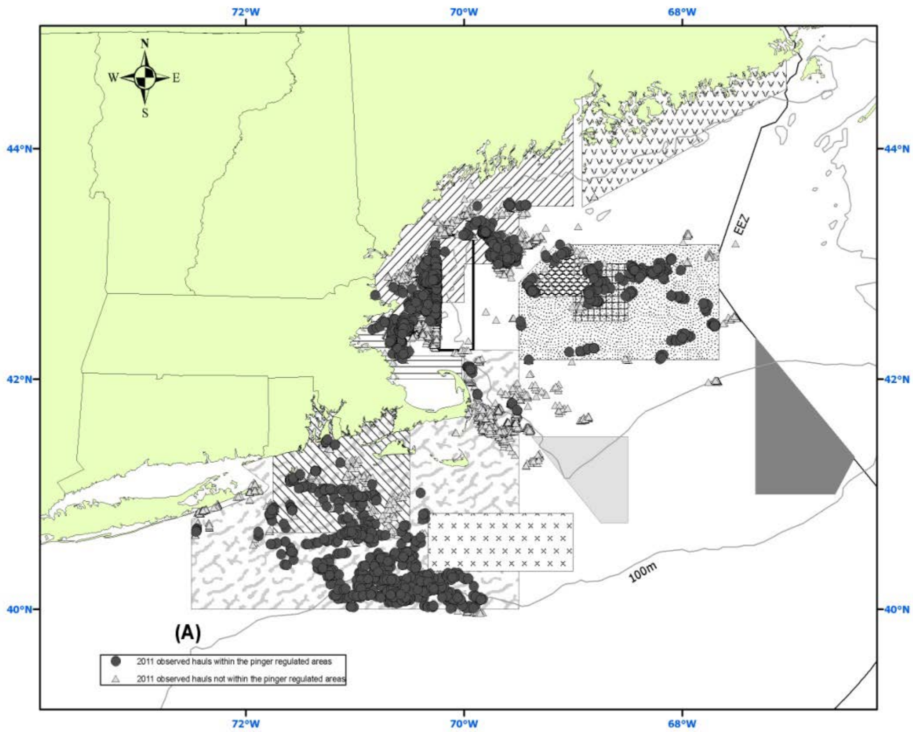


Figure 2. 2011 Northeast sink gillnet observed hauls (A) and observed takes (B).




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 Closure

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure

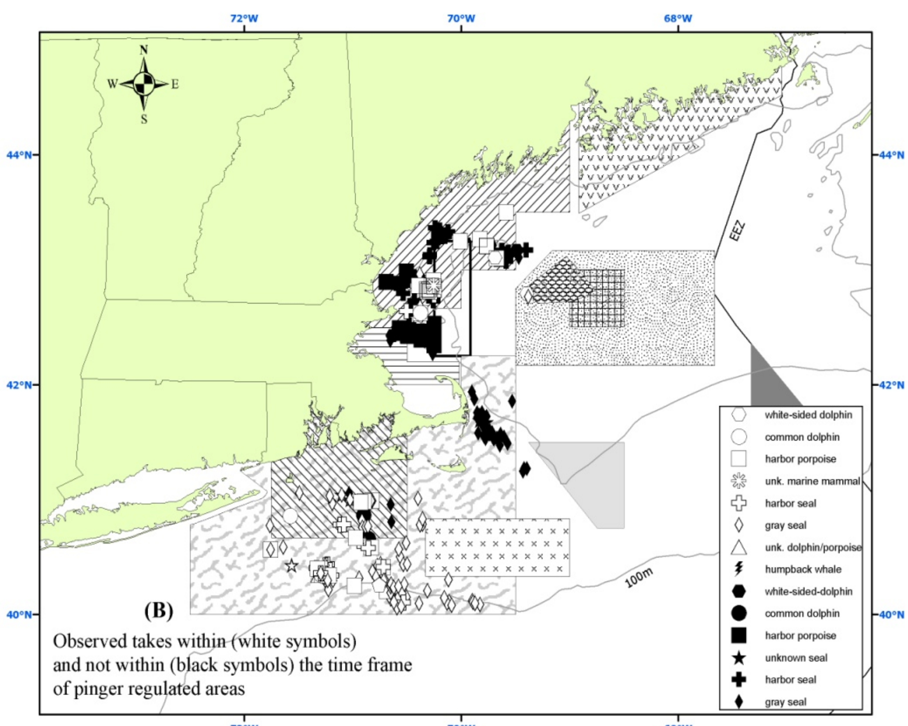


Figure 3. 2012 Northeast sink gillnet observed hauls (A) and observed takes (B).

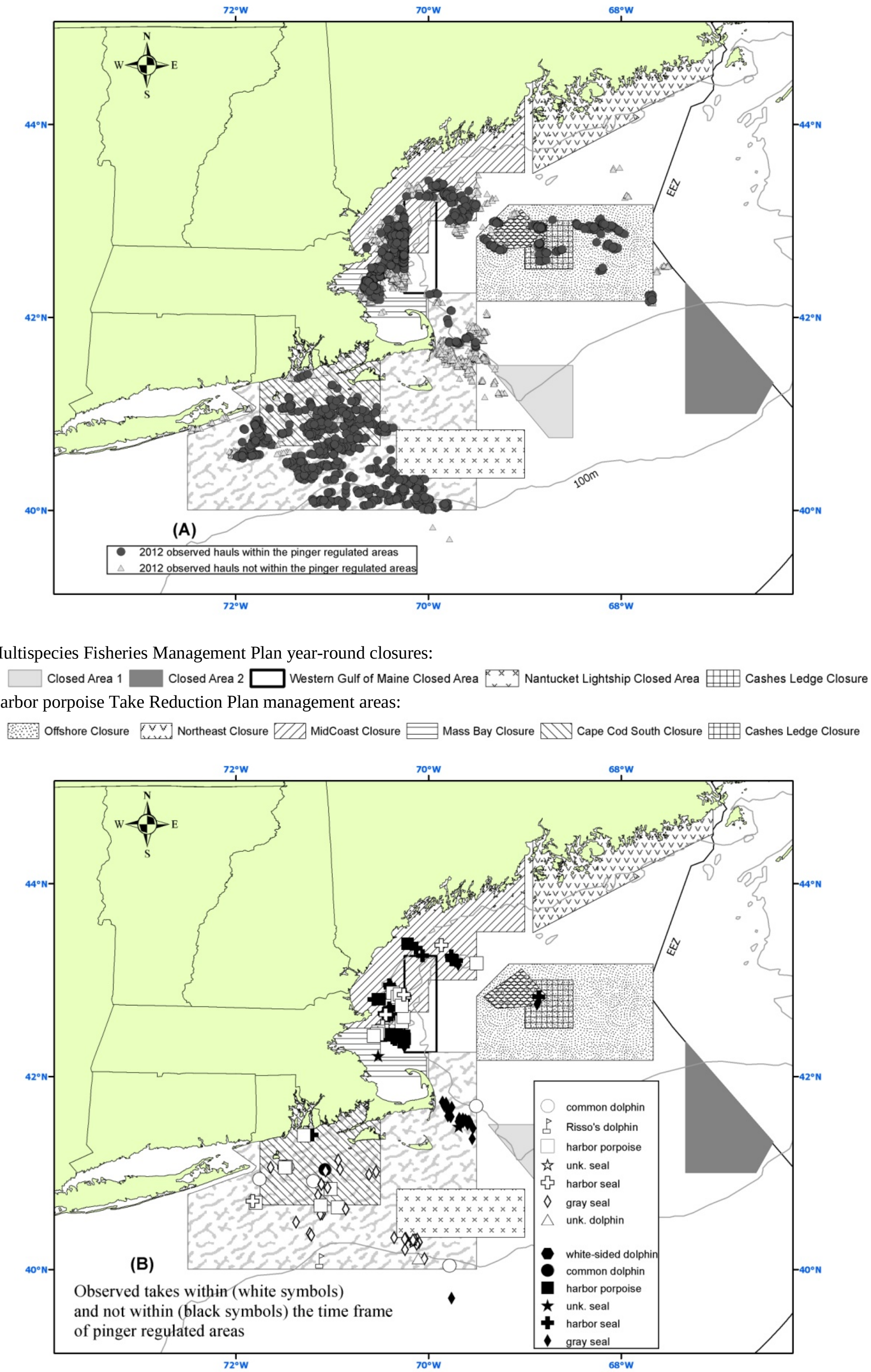
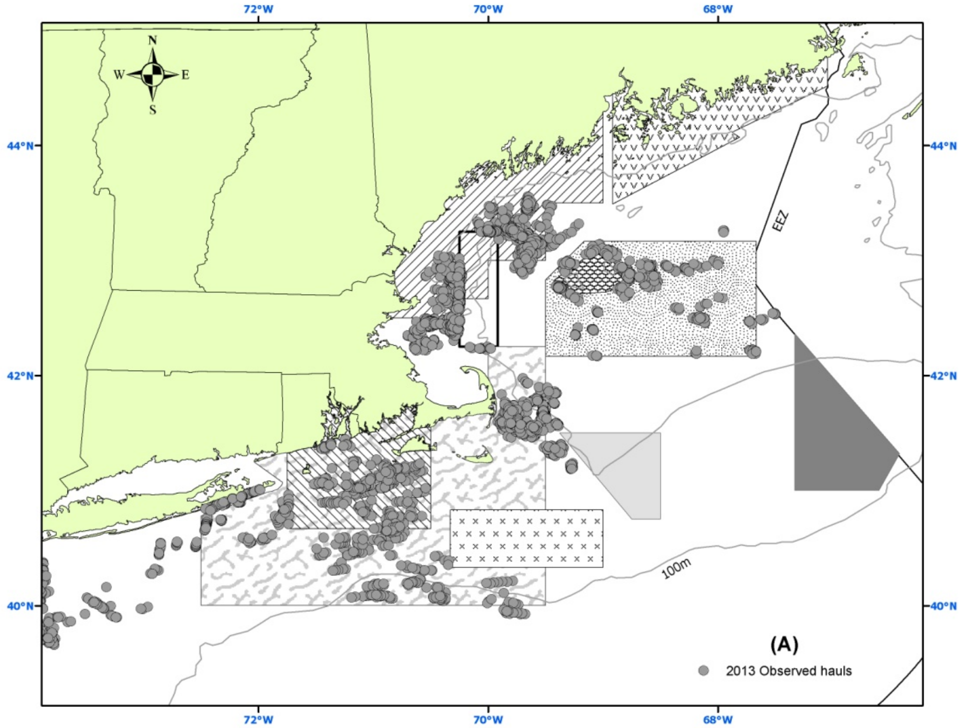


Figure 4. 2013 Northeast sink gillnet observed hauls (A) and observed takes (B).




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 Closure

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure

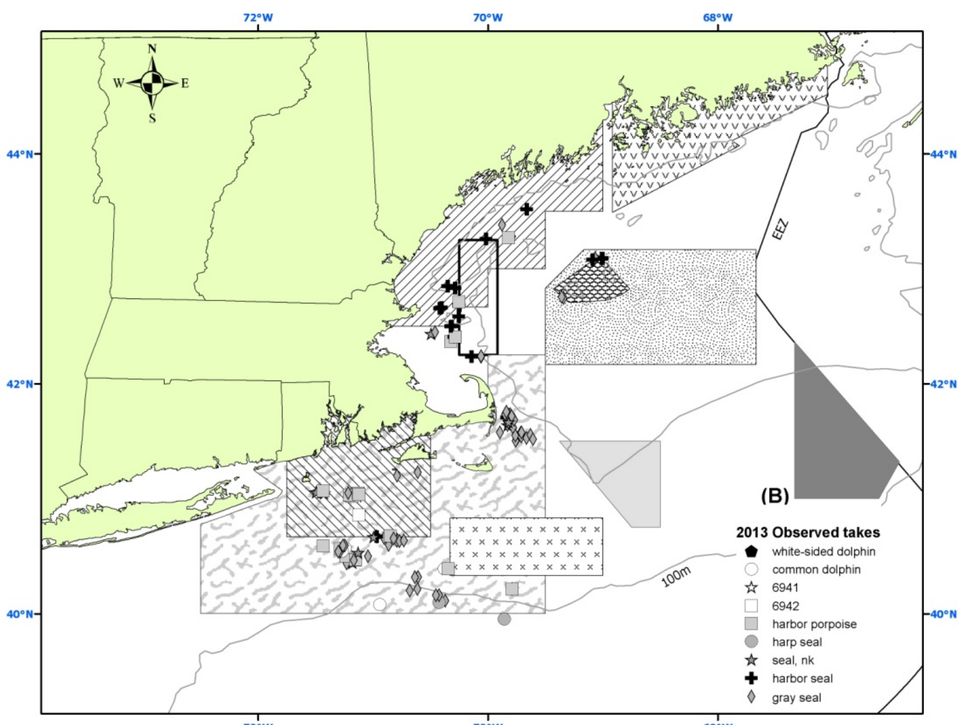
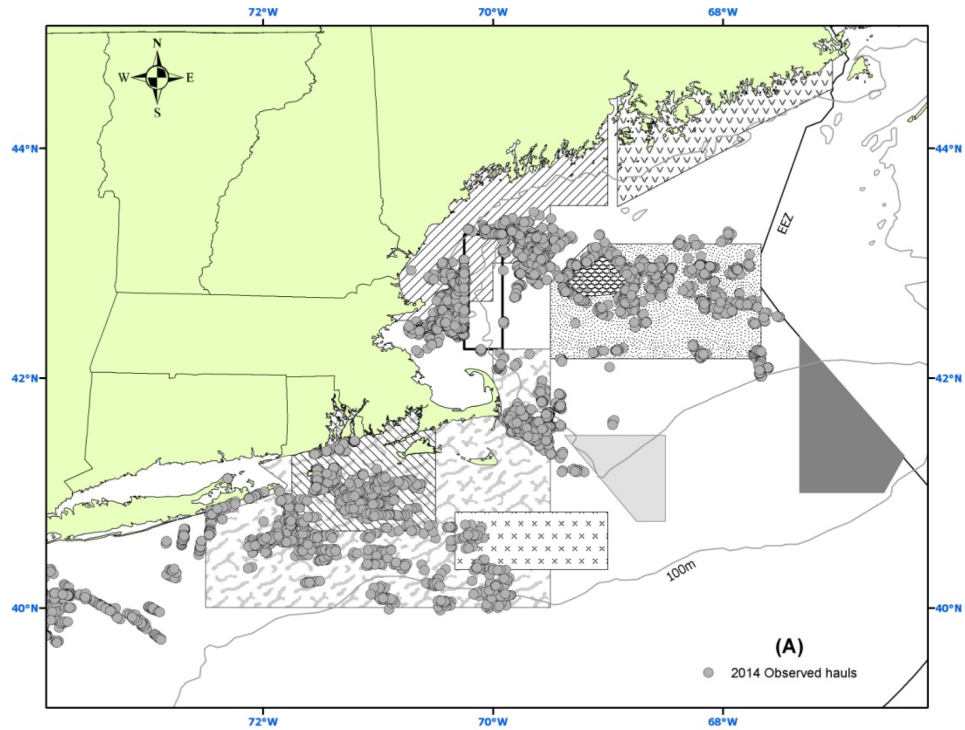


Figure 5. 2014 Northeast sink gillnet observed hauls (A) and observed takes (B).




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 Closure

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure  Northeast Closure  MidCoast Closure  Mass Bay Closure  Cape Cod South Closure  Cashes Ledge Closure

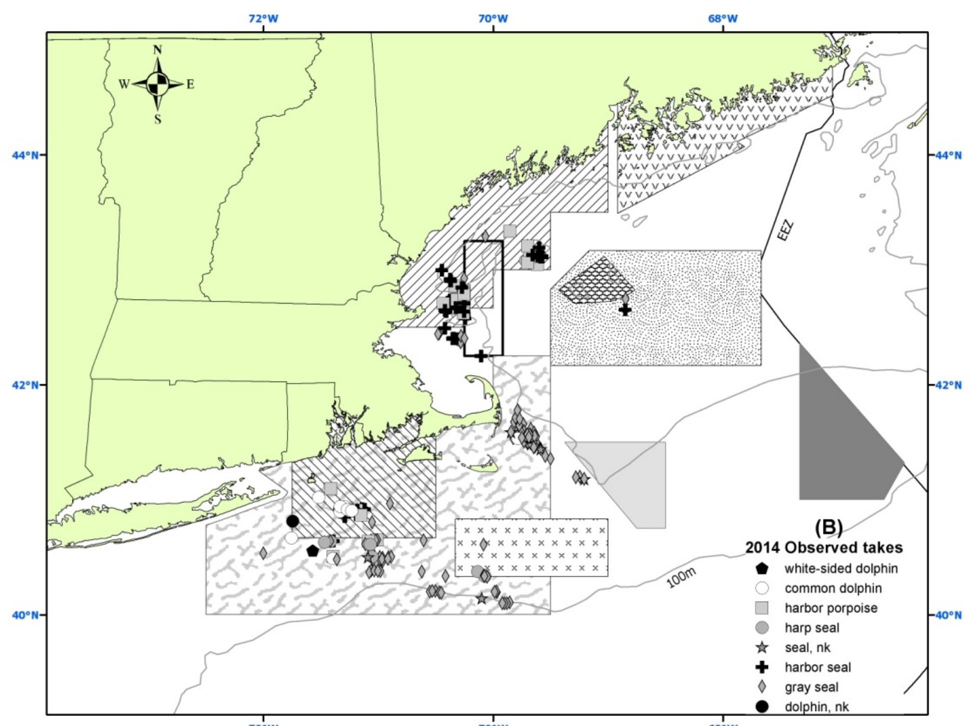
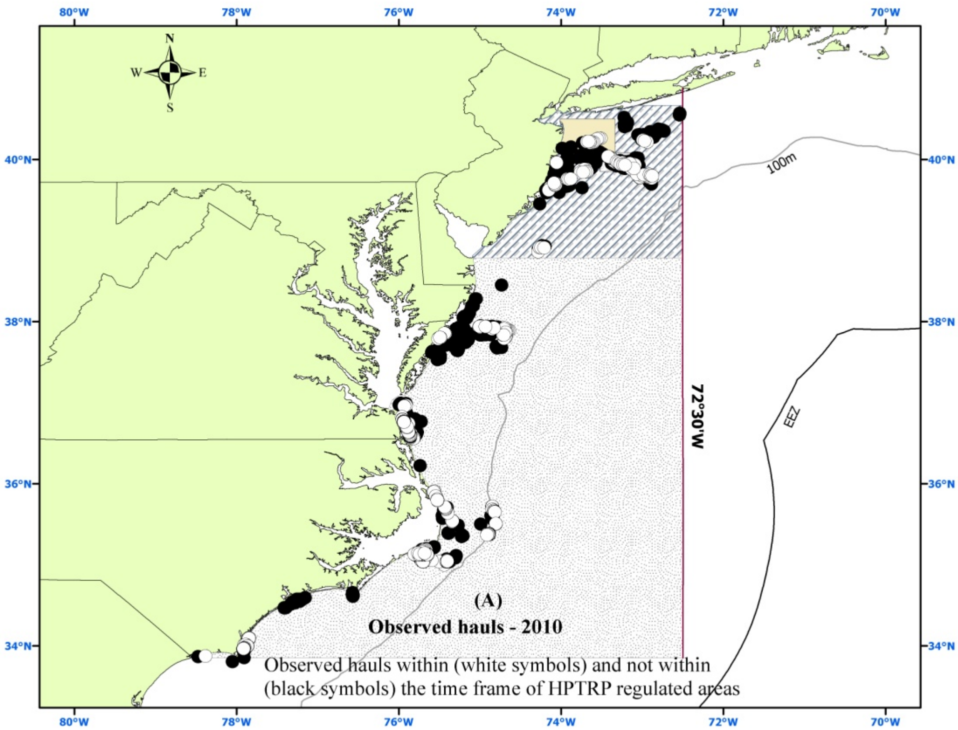


Figure 6. 2010 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).




Harbor porpoise Take Reduction Plan management areas:

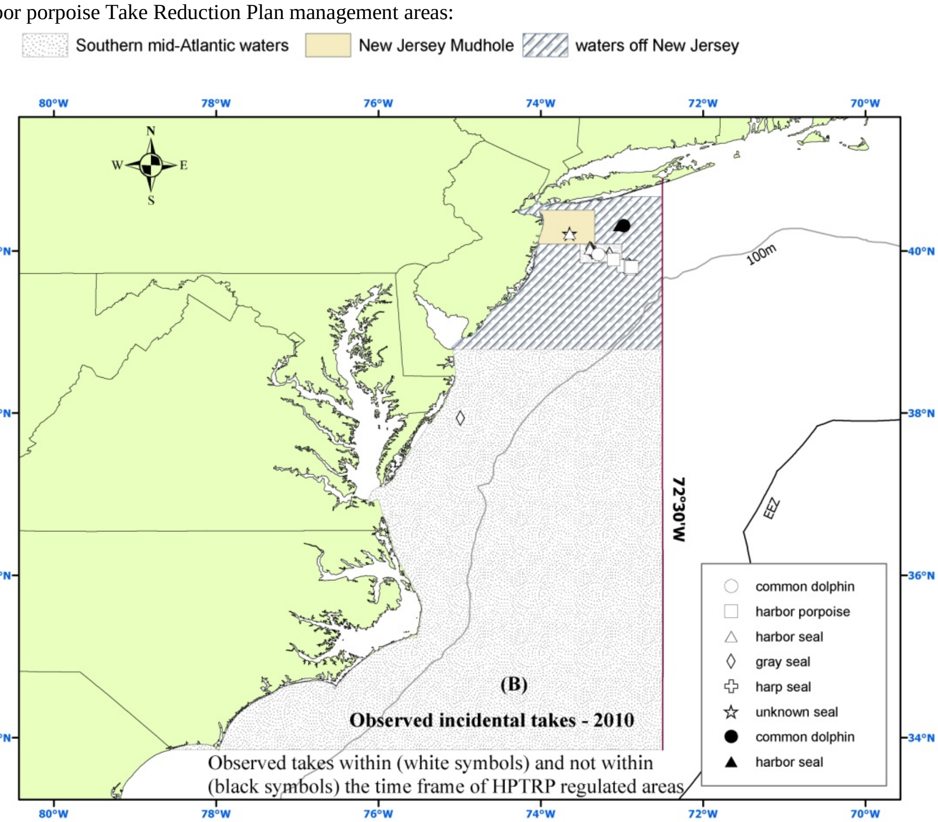
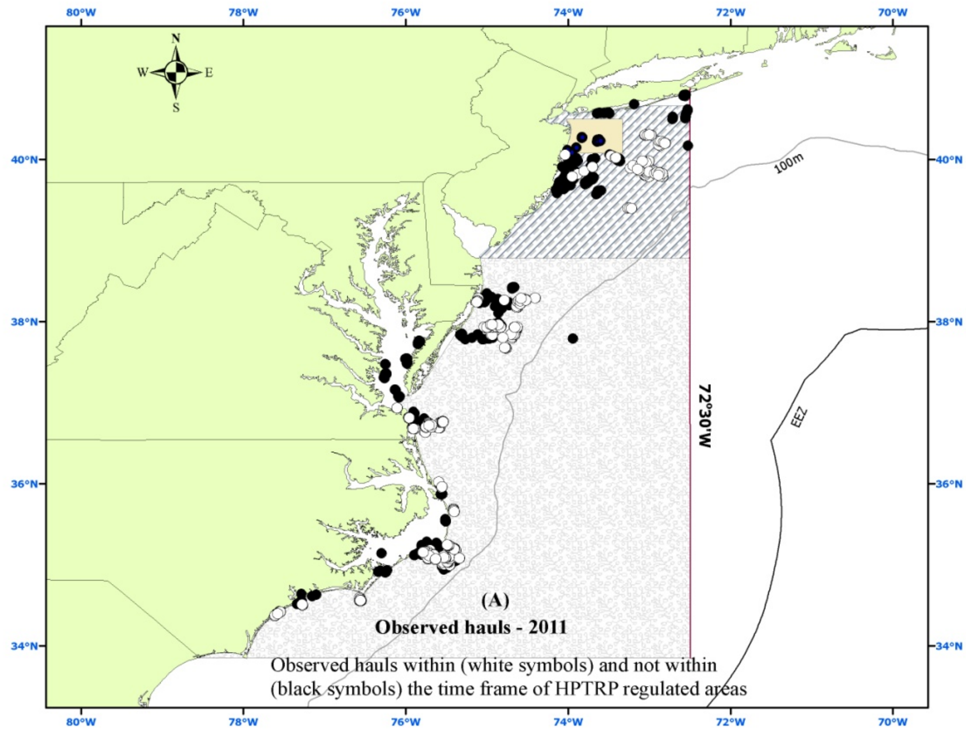


Figure 7. 2011 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).




Harbor porpoise Take Reduction Plan management areas:

Southern mid-Atlantic waters | New Jersey Mudhole | waters off New Jersey

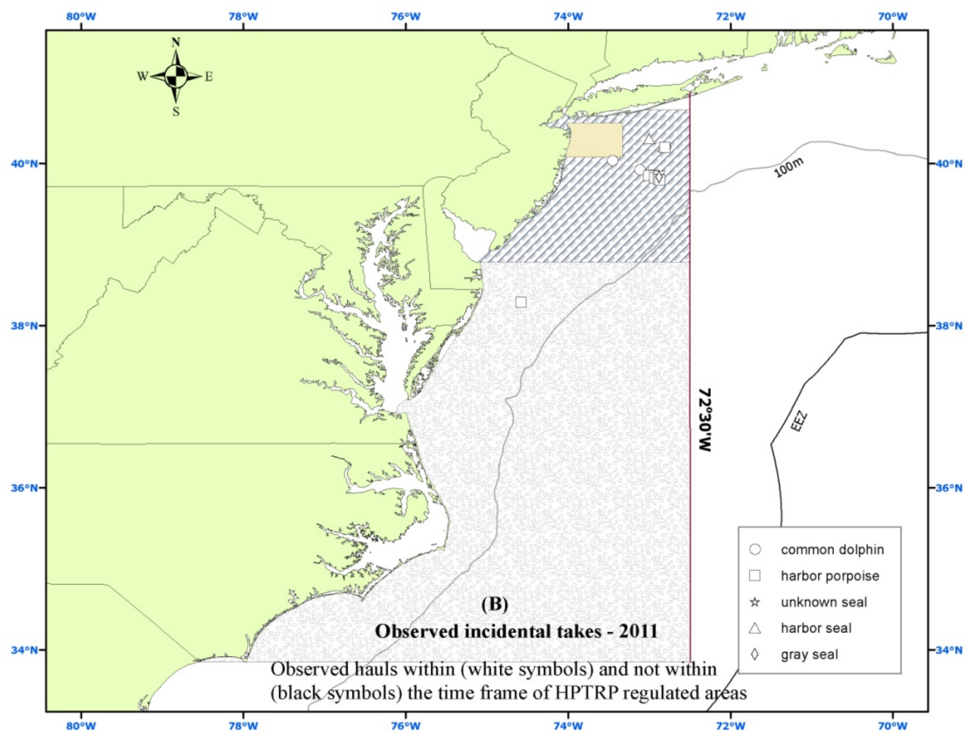
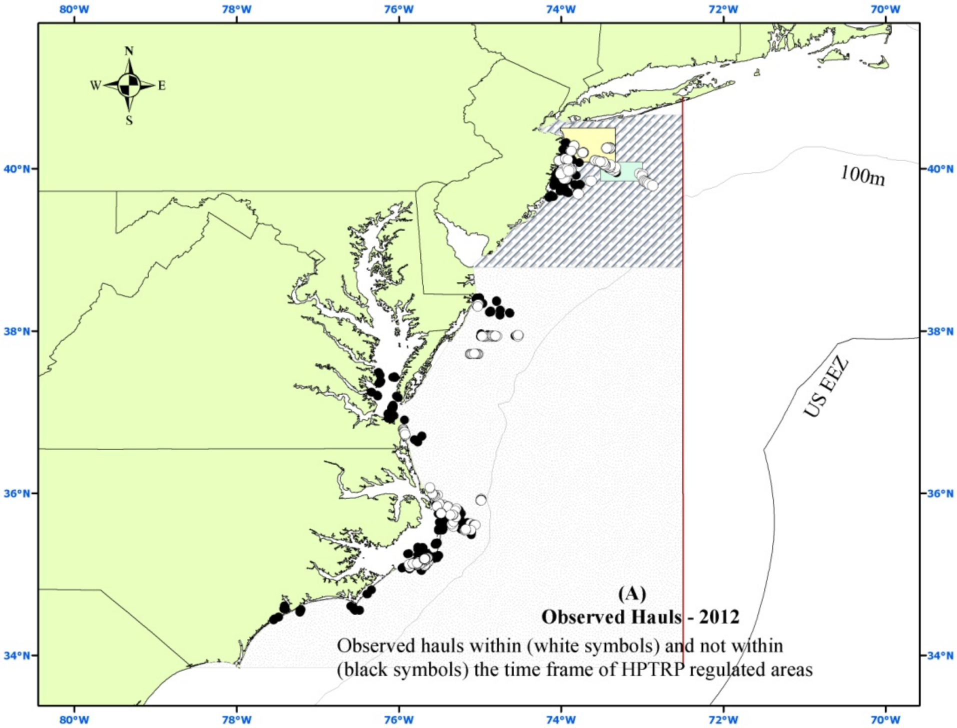


Figure 8. 2012 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).




Harbor porpoise Take Reduction Plan management areas:

Southern mid-Atlantic waters New Jersey Mudhole waters off New Jersey

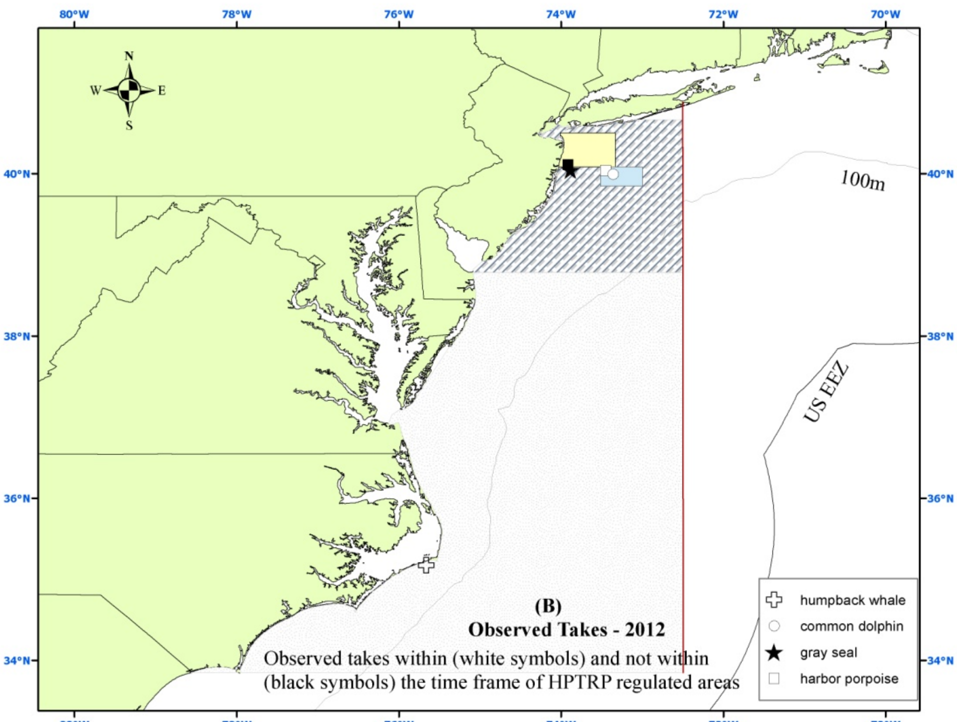
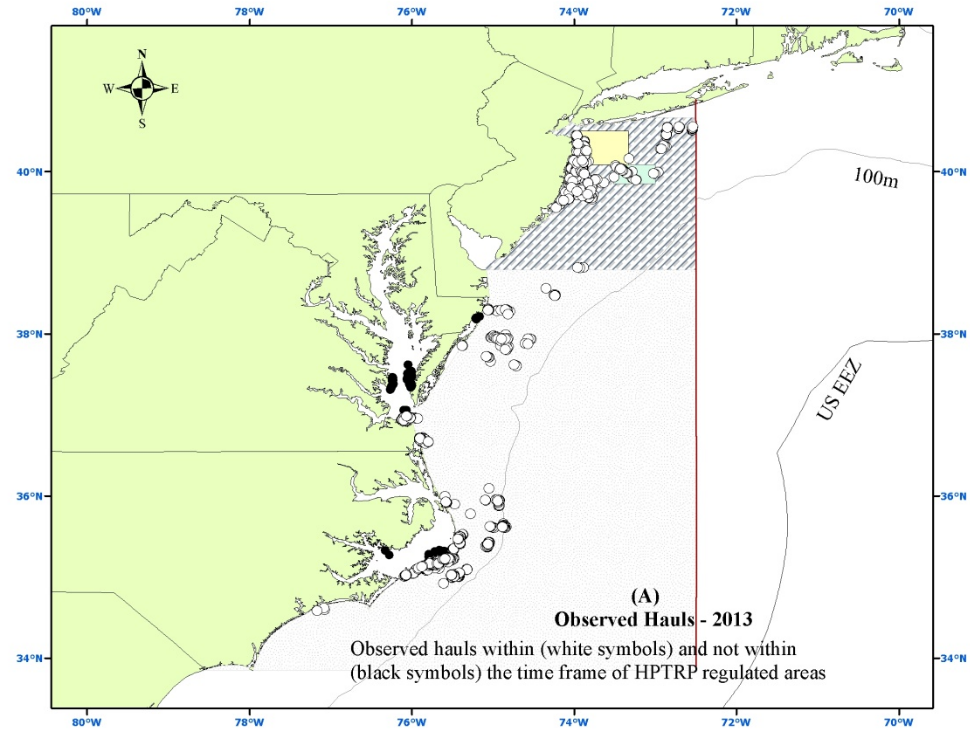


Figure 9. 2013 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).




Harbor porpoise Take Reduction Plan management areas:

Southern mid-Atlantic waters | New Jersey Mudhole | waters off New Jersey

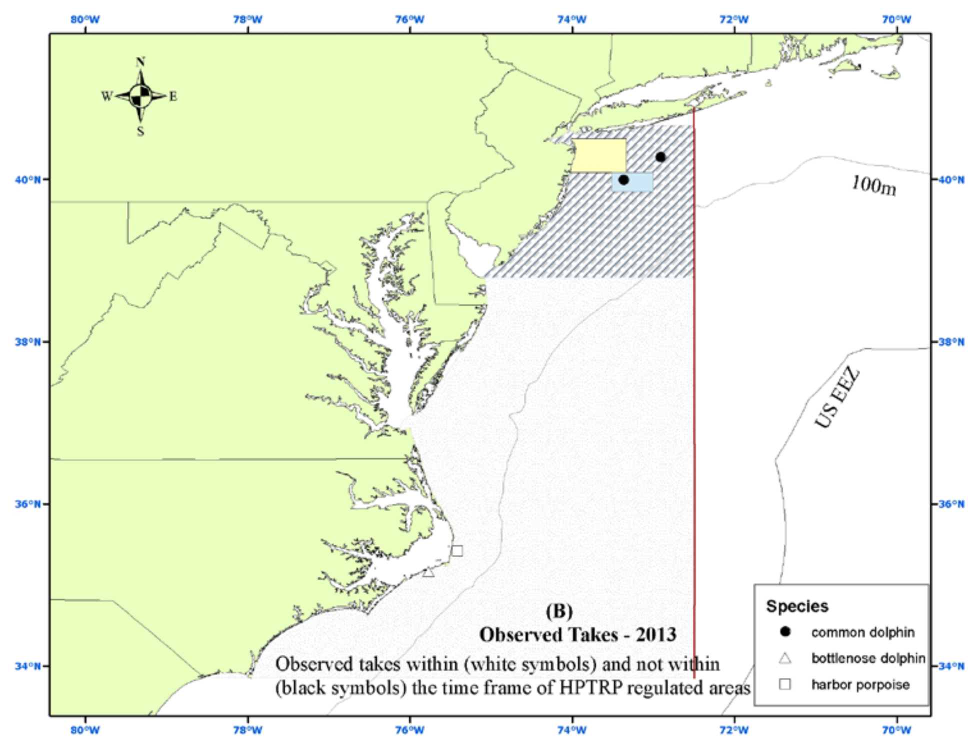
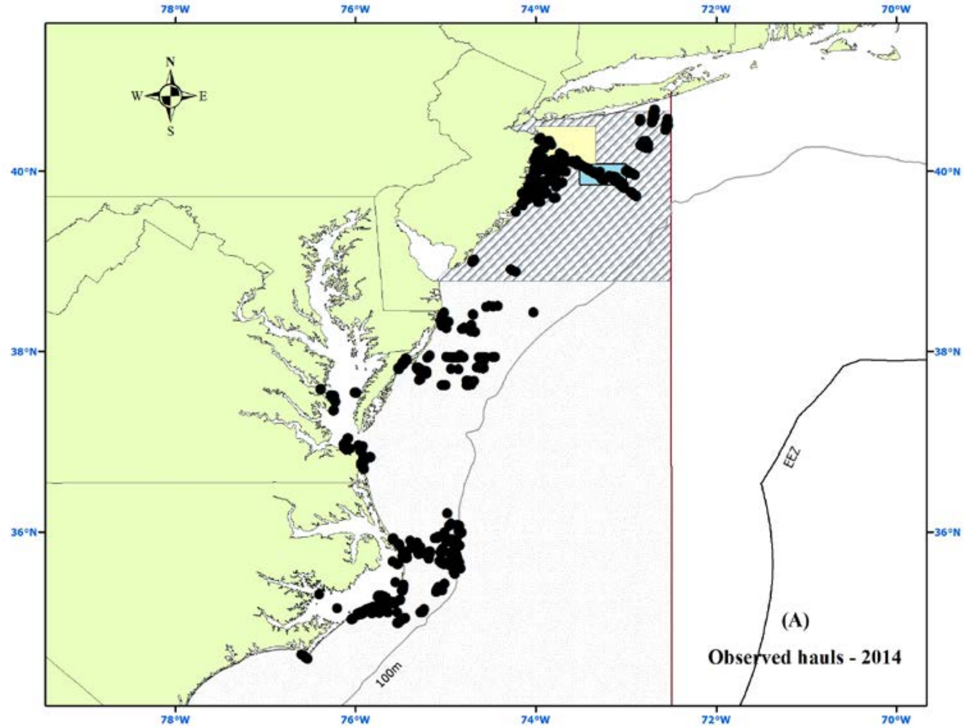


Figure 10. 2014 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).




Harbor porpoise Take Reduction Plan management areas:

Southern mid-Atlantic waters New Jersey Mudhole waters off New Jersey

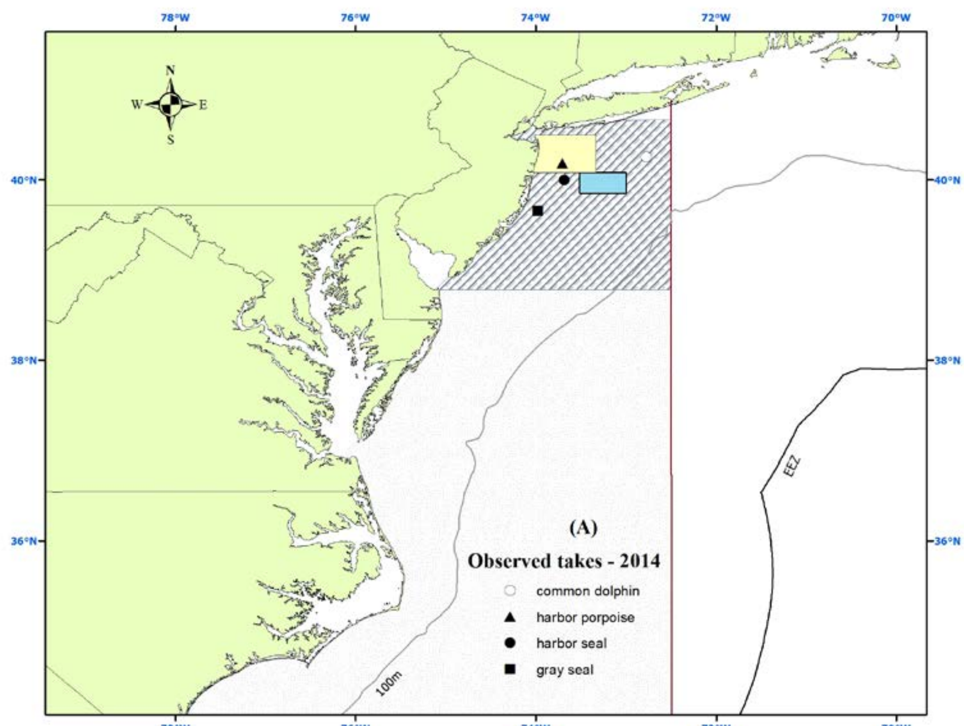


Figure 11. 2010 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

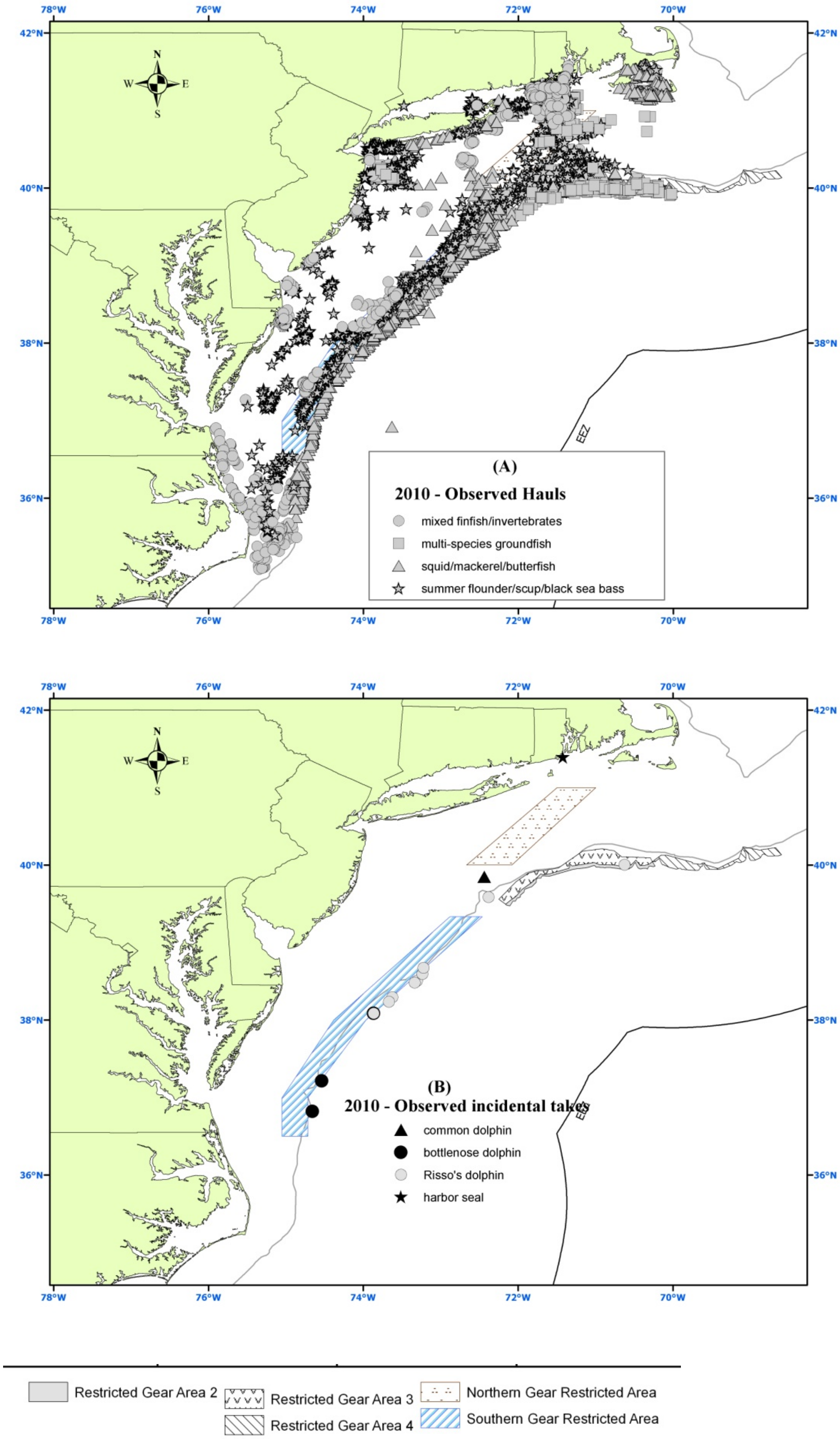


Figure 12. 2011 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

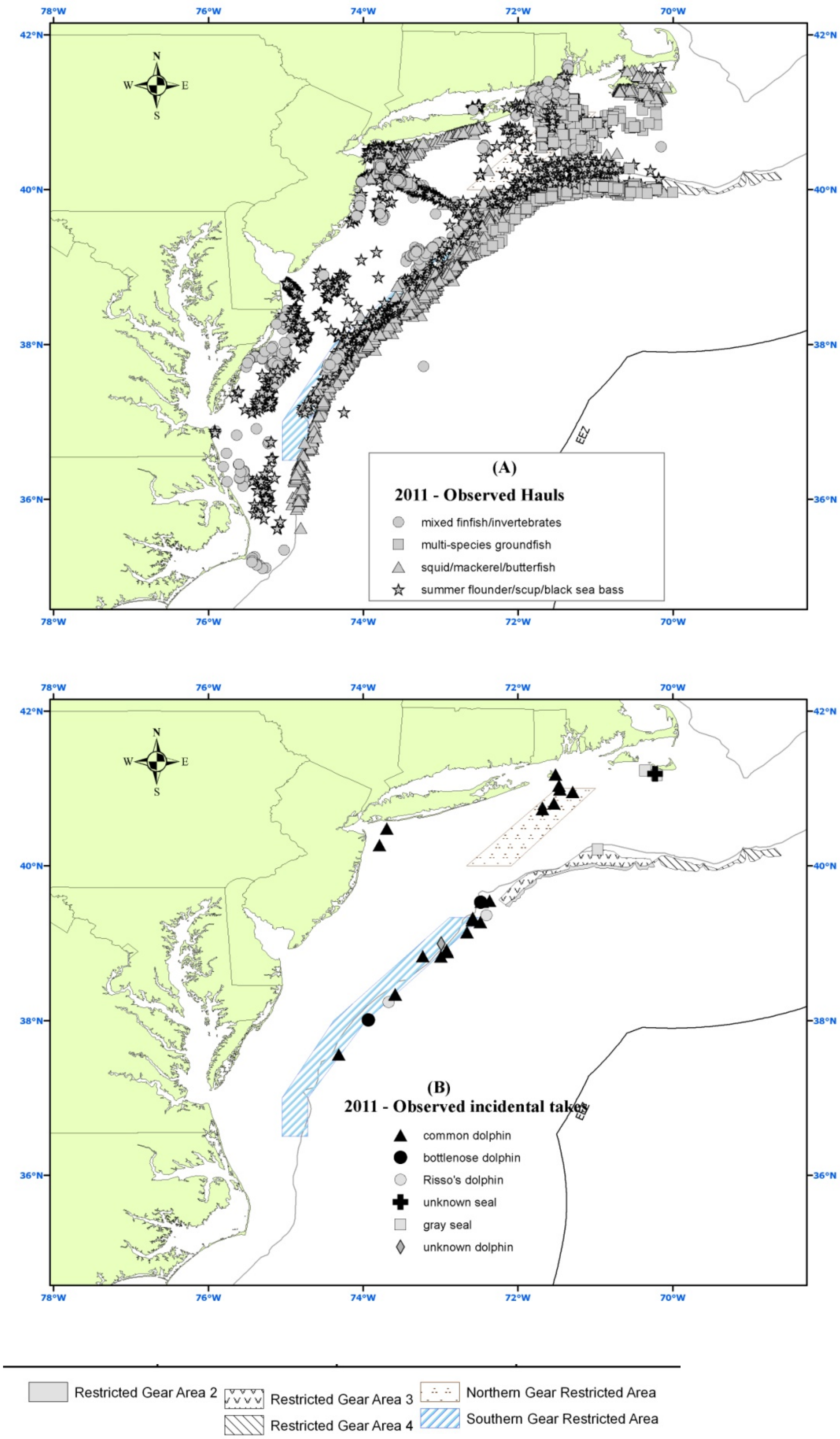


Figure 13. 2012 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

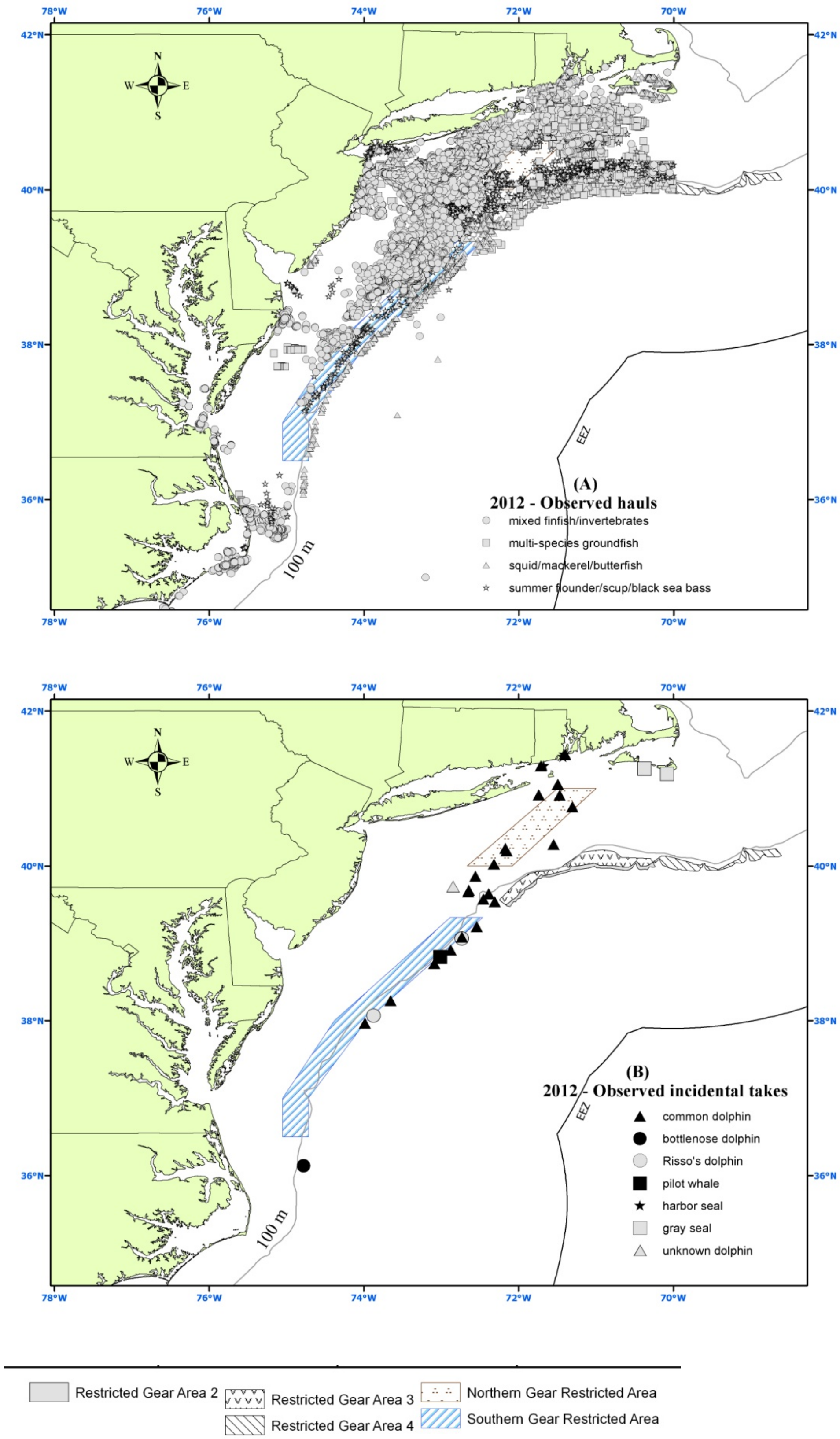


Figure 14. 2013 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

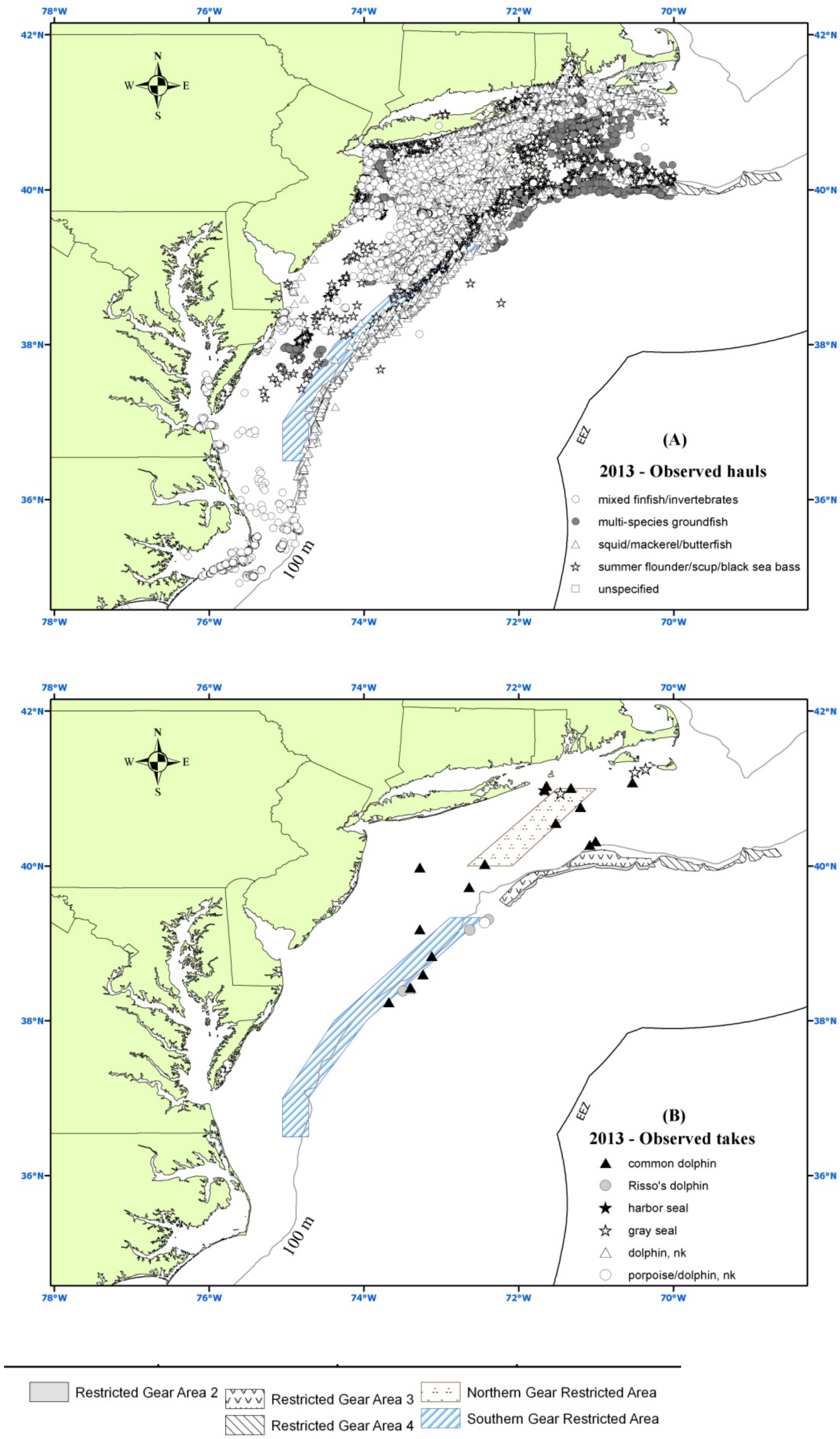


Figure 15. 2014 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

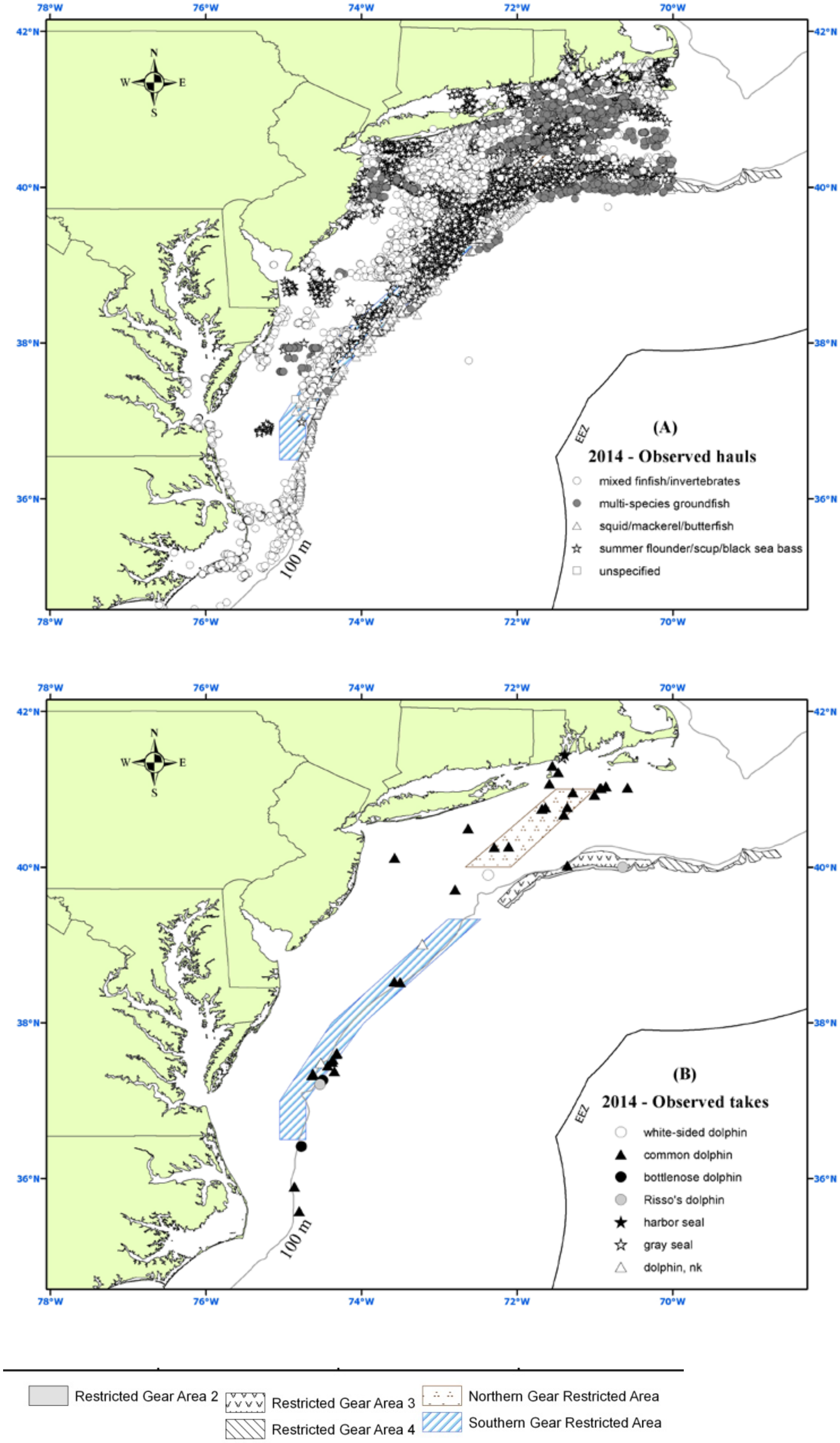


Figure 16. 2010 Northeast bottom trawl observed tows (A) and observed takes (B).

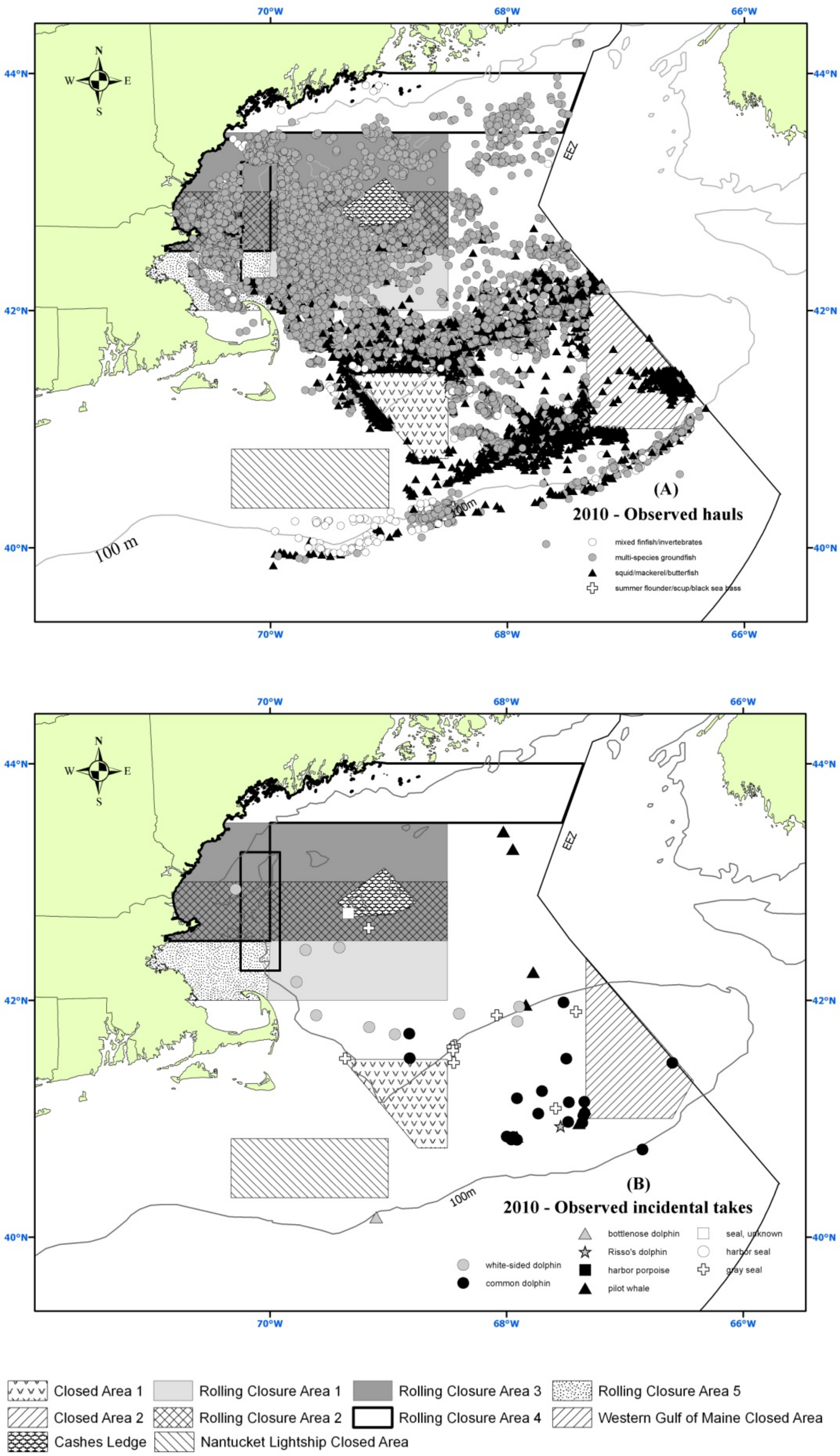


Figure 17. 2011 Northeast bottom trawl observed tows (A) and observed takes (B).

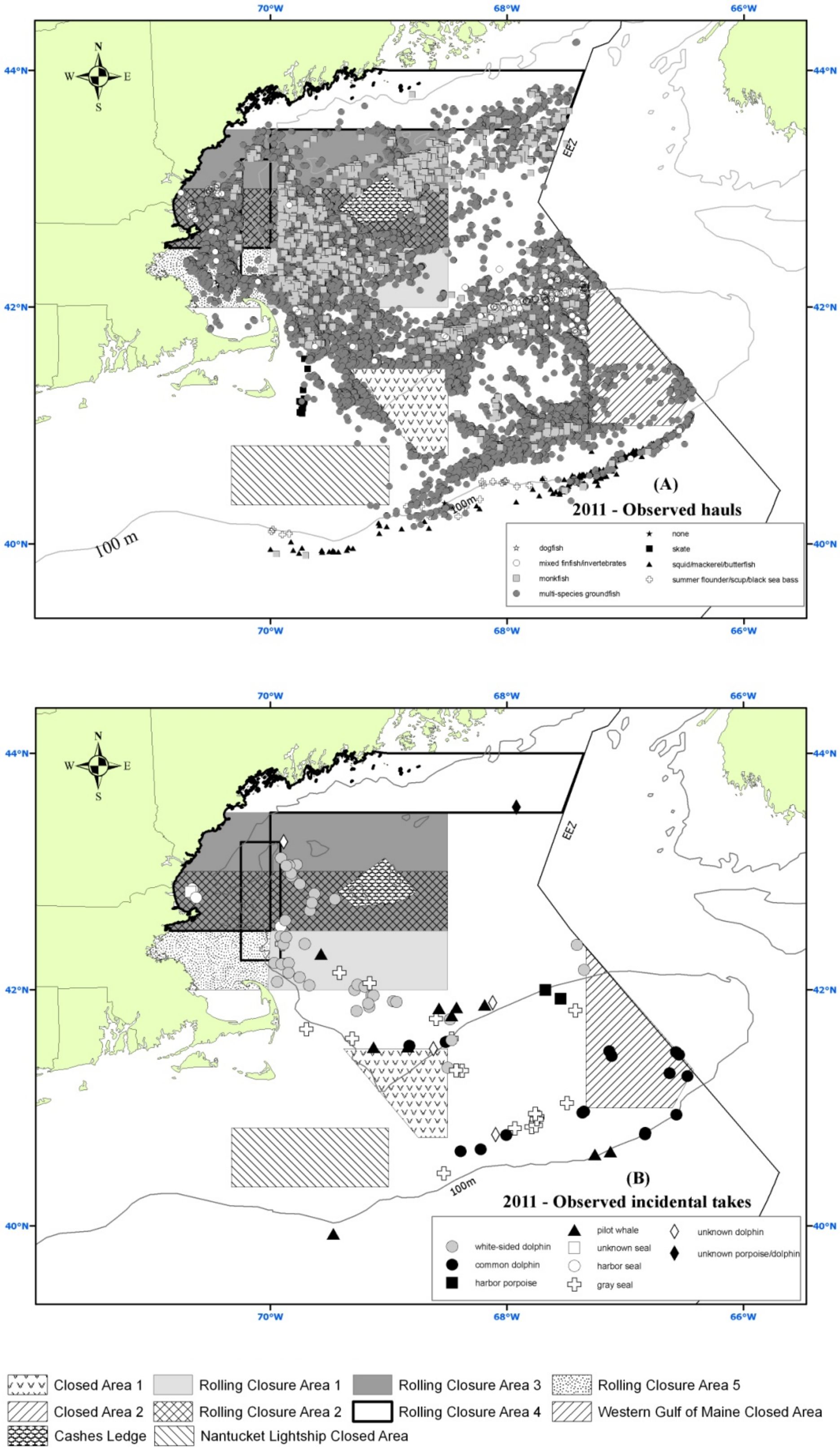


Figure 18. 2012 Northeast bottom trawl observed tows (A) and observed takes (B).

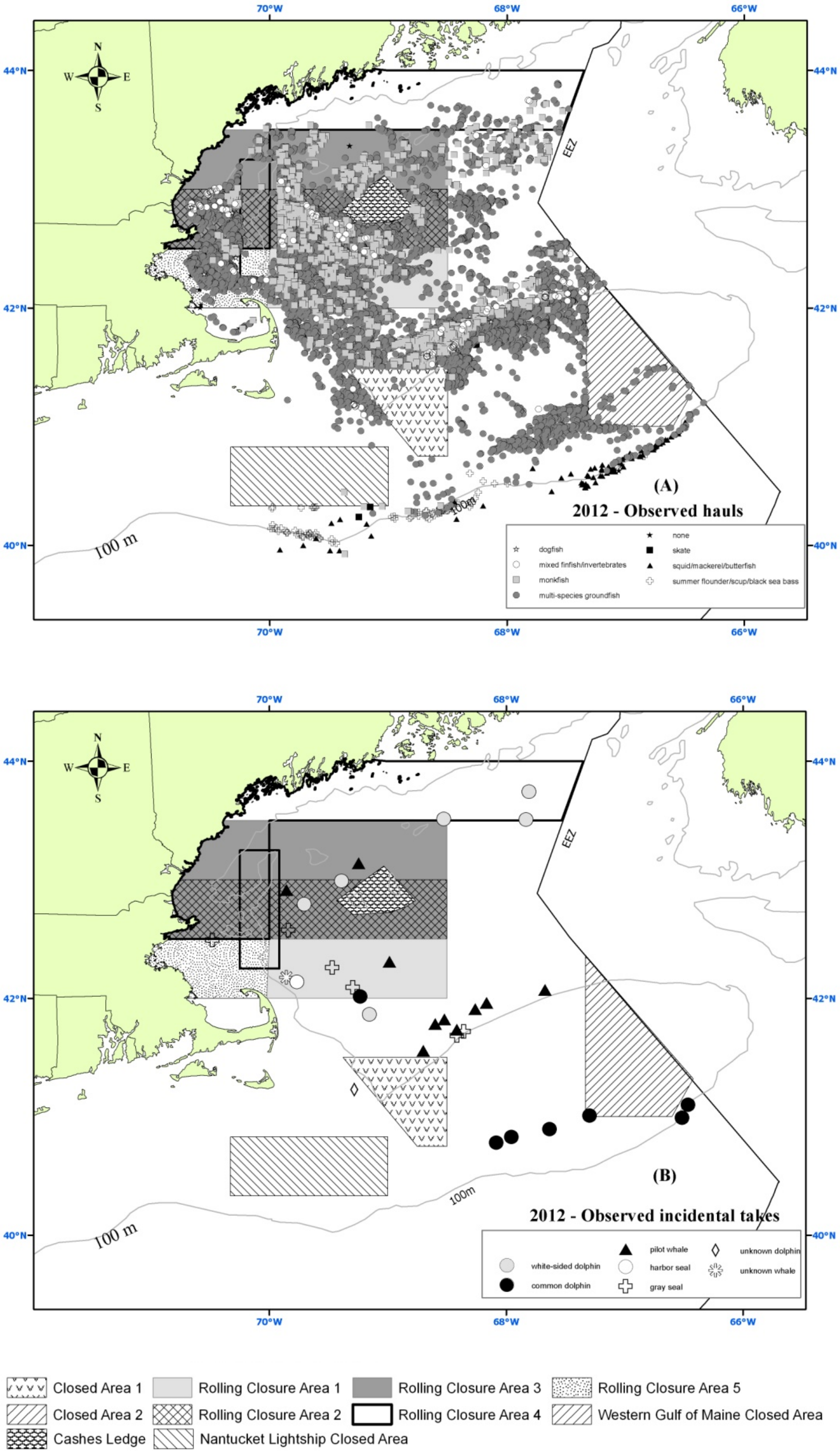


Figure 19. 2013 Northeast bottom trawl observed tows (A) and observed takes (B).

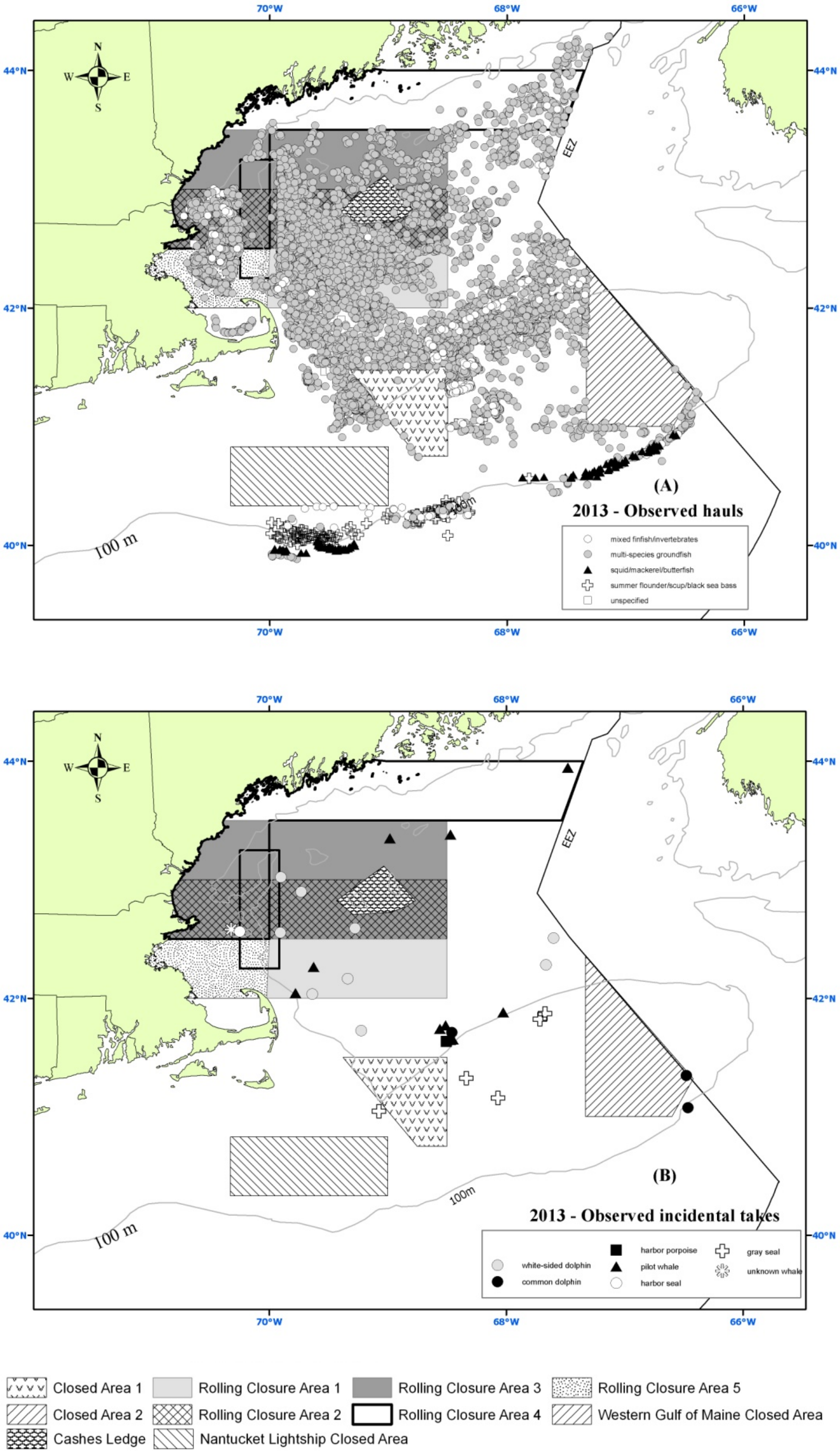


Figure 20. 2014 Northeast bottom trawl observed tows (A) and observed takes (B).

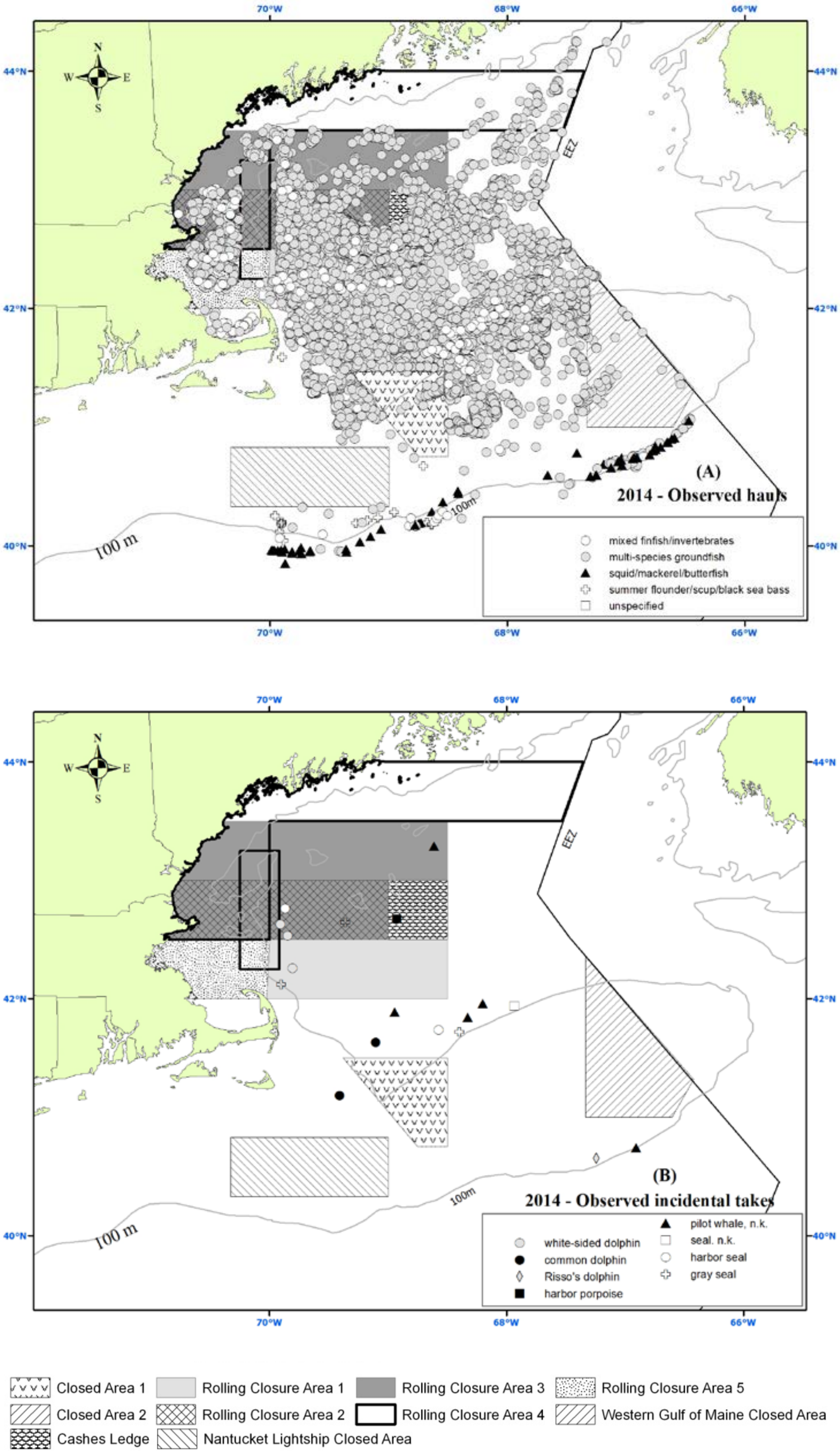


Figure 21. 2010 Northeast mid-water trawl observed tows (A) and observed takes (B).

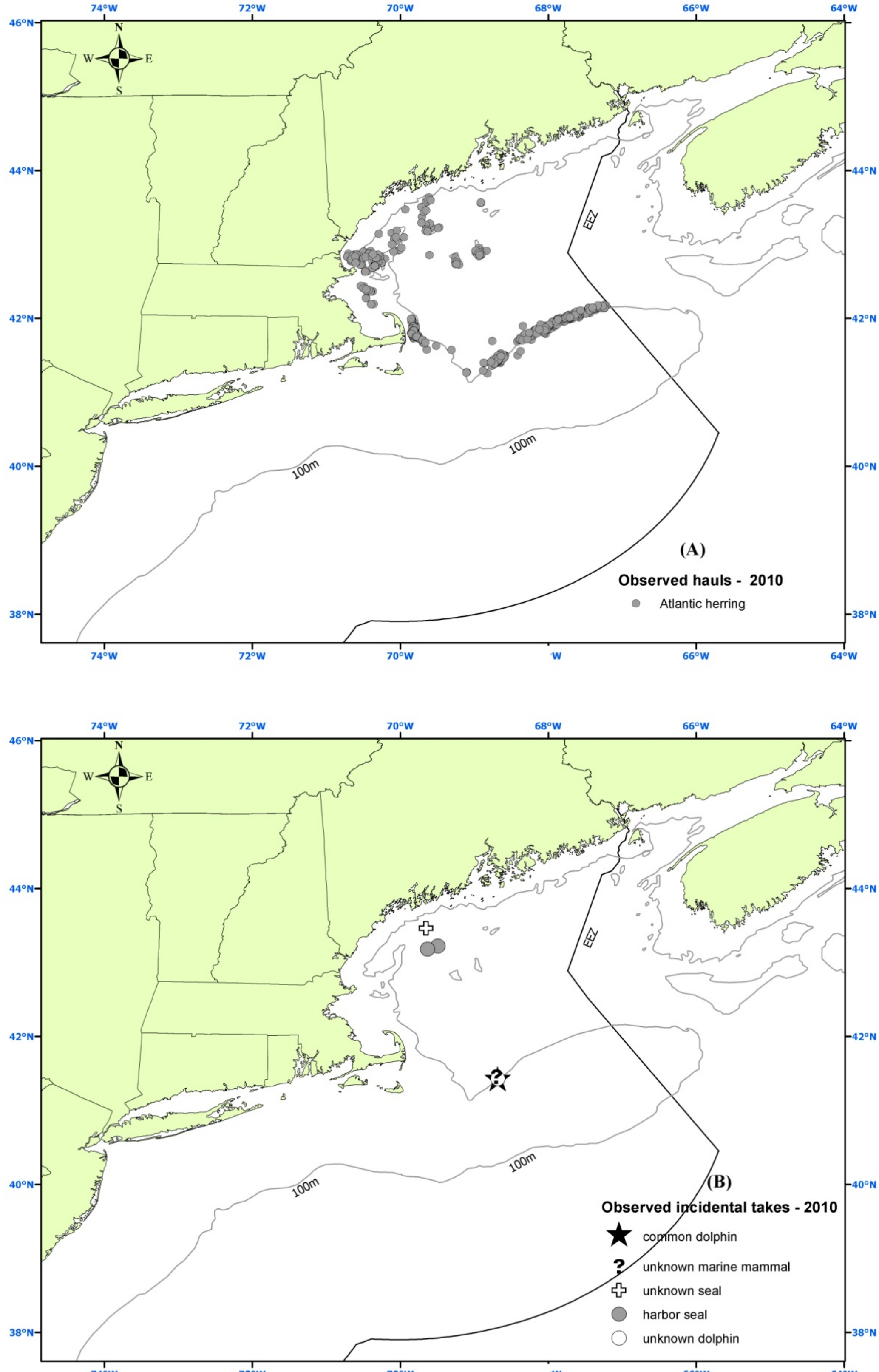
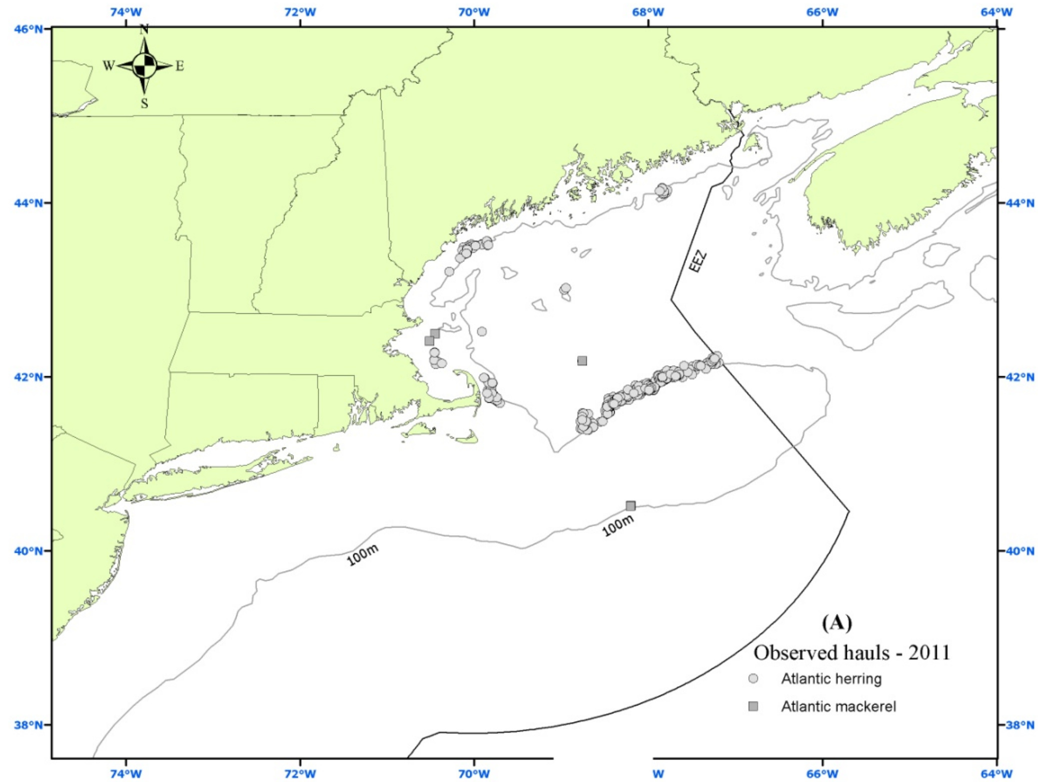


Figure 22. 2011 Northeast mid-water trawl observed tows (A) and observed takes (B).



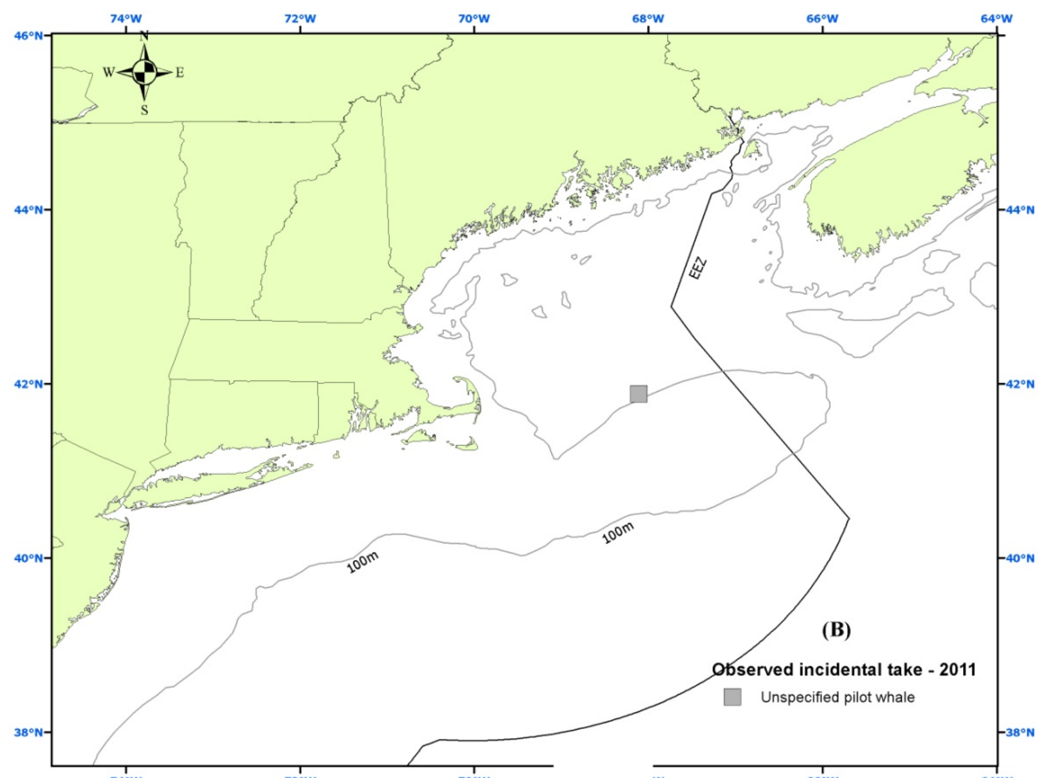



Figure 23. 2012 Northeast mid-water trawl observed tows (A) and observed takes (B).

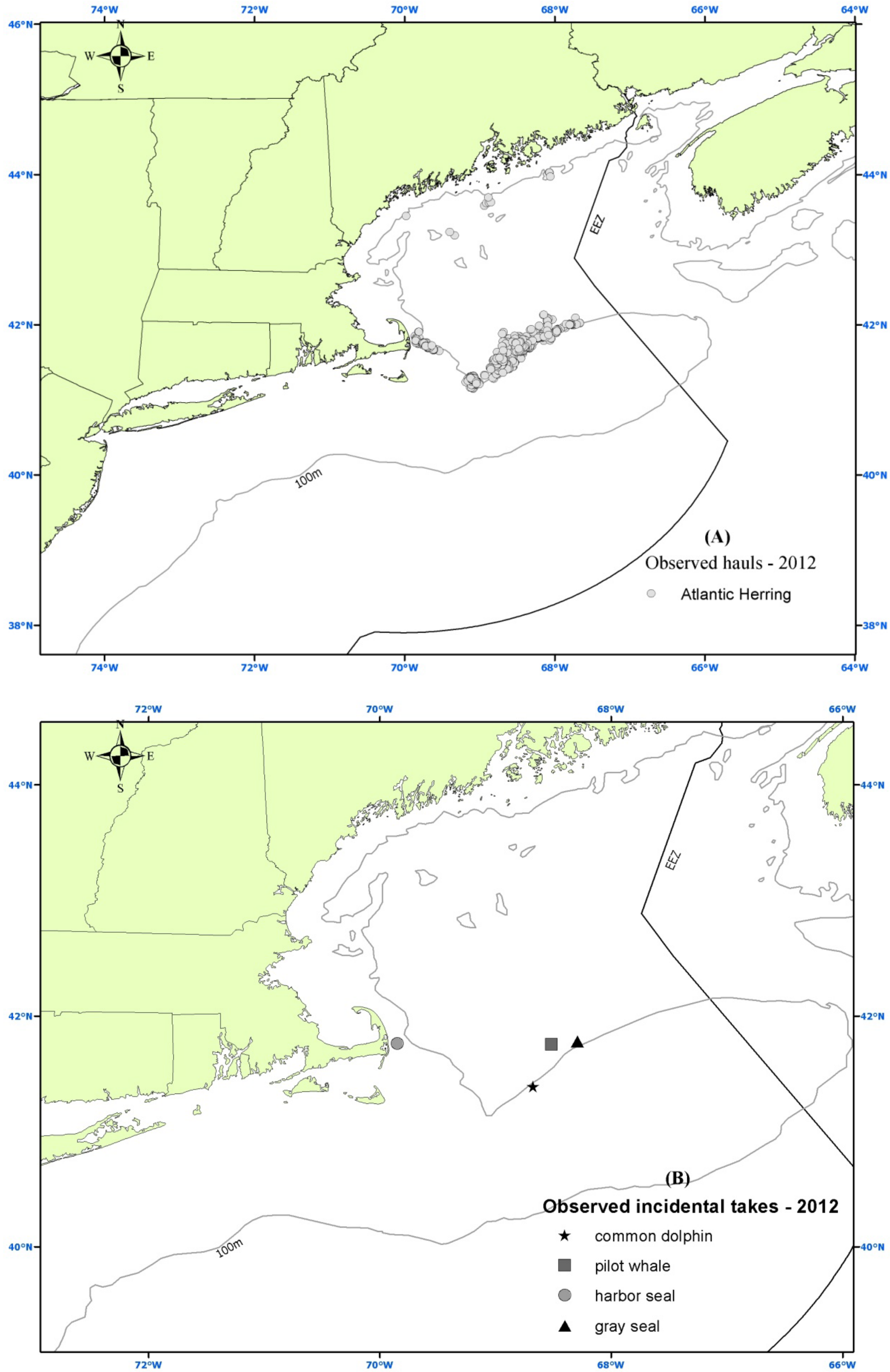
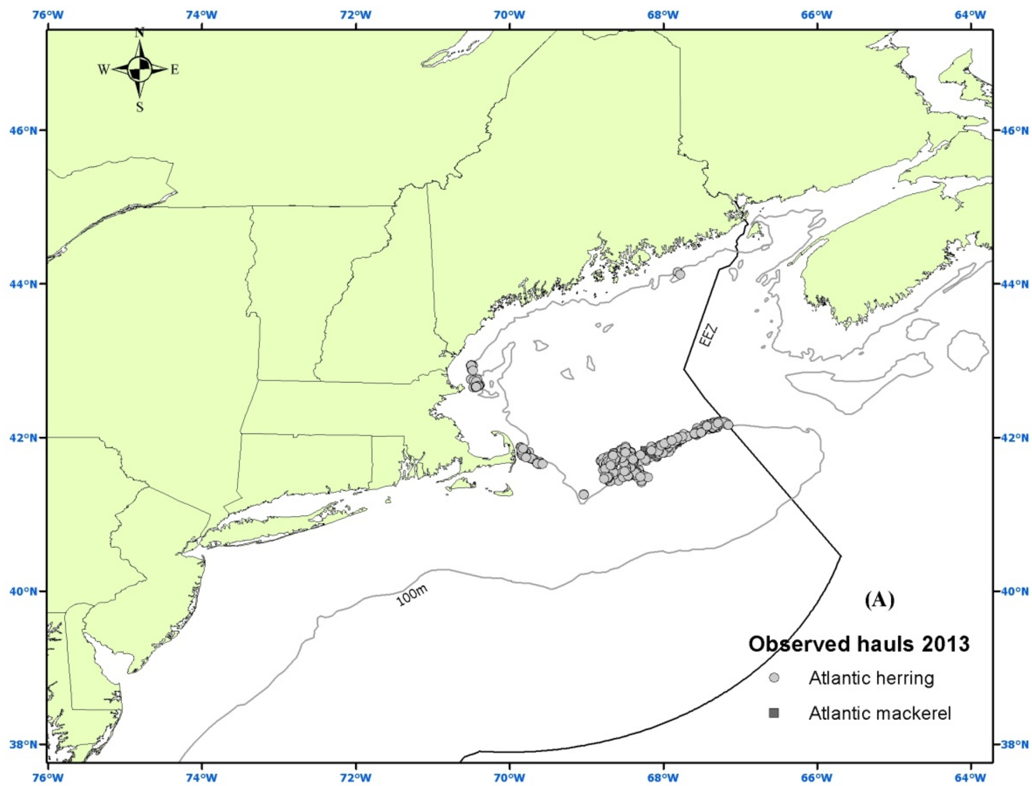


Figure 24. 2013 Northeast mid-water trawl observed tows (A) and observed takes (B).



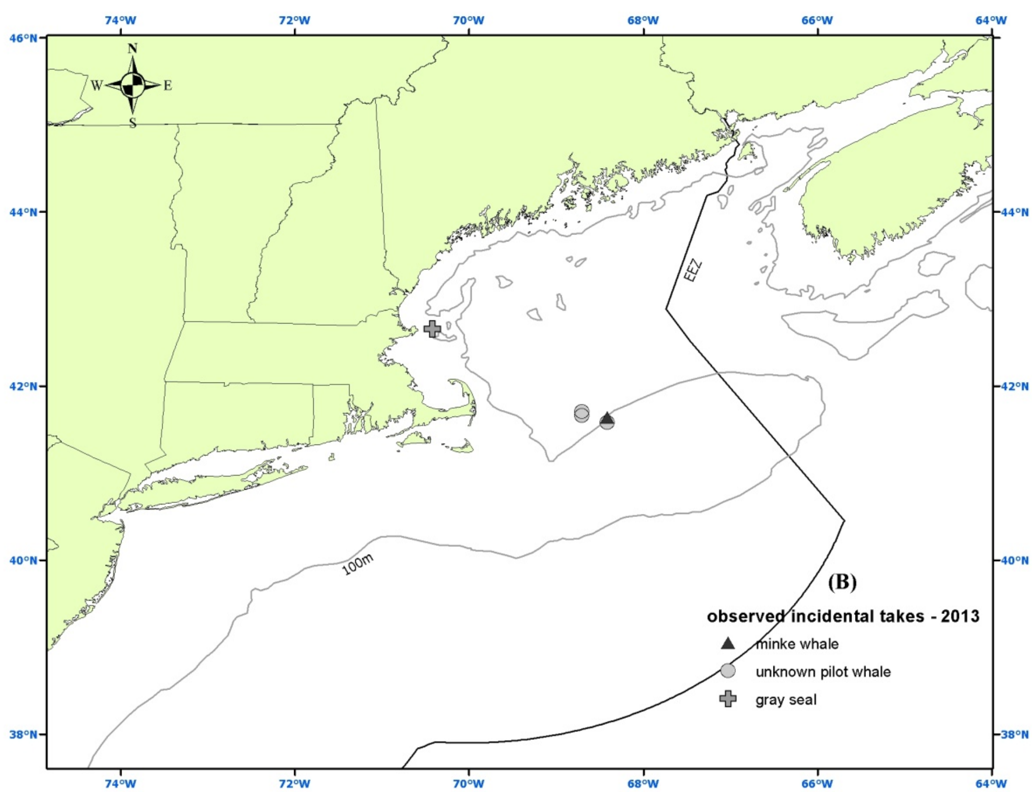



Figure 25. 2014 Northeast mid-water trawl observed tows (A) and observed takes (B).

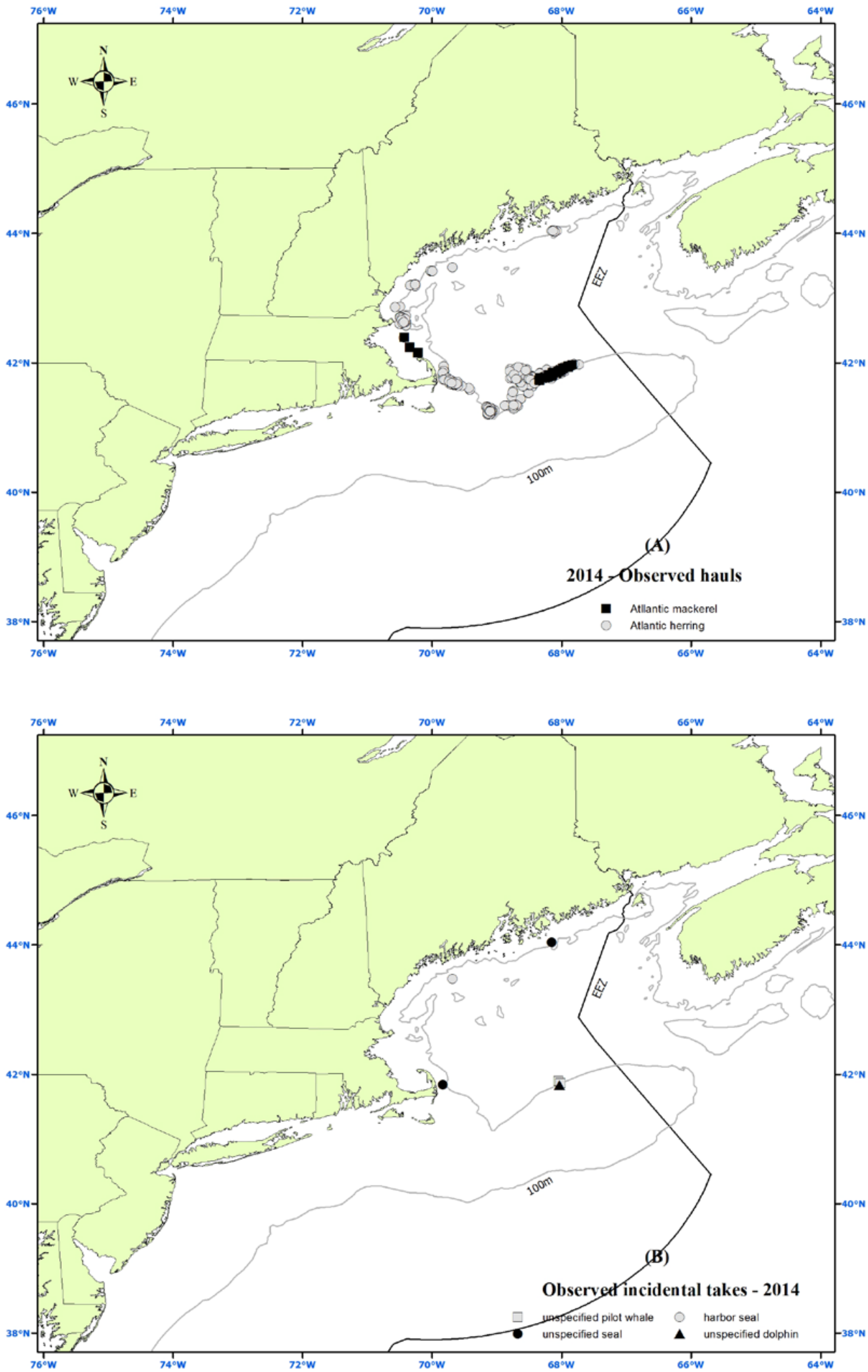
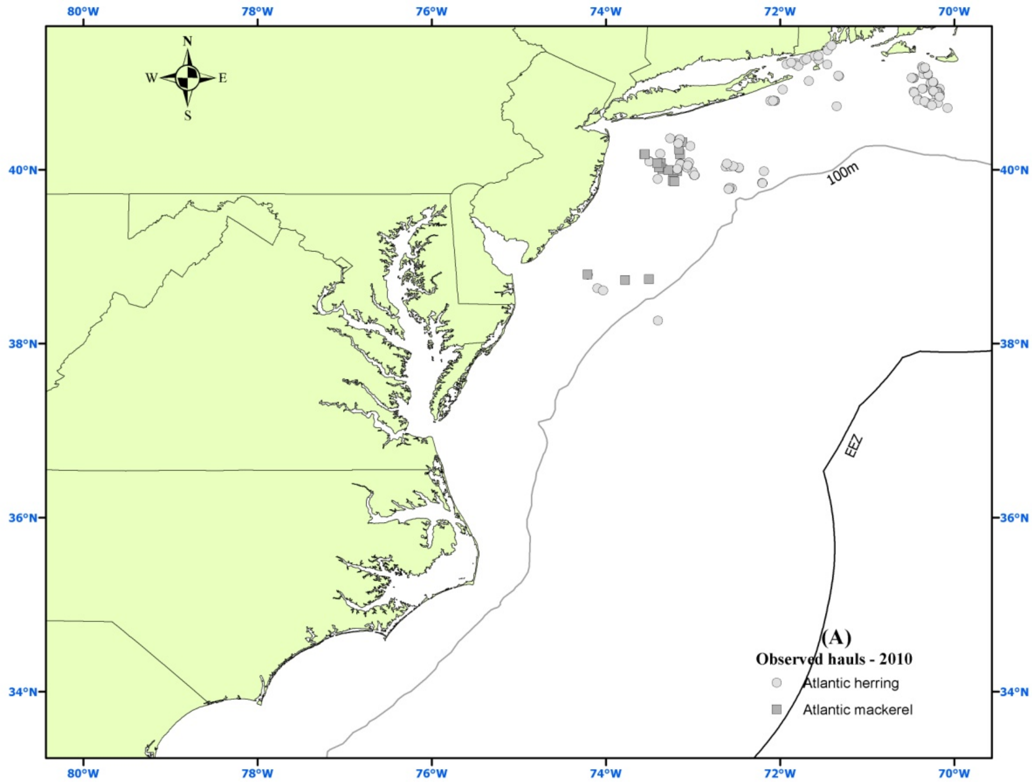


Figure 26. 2010 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).



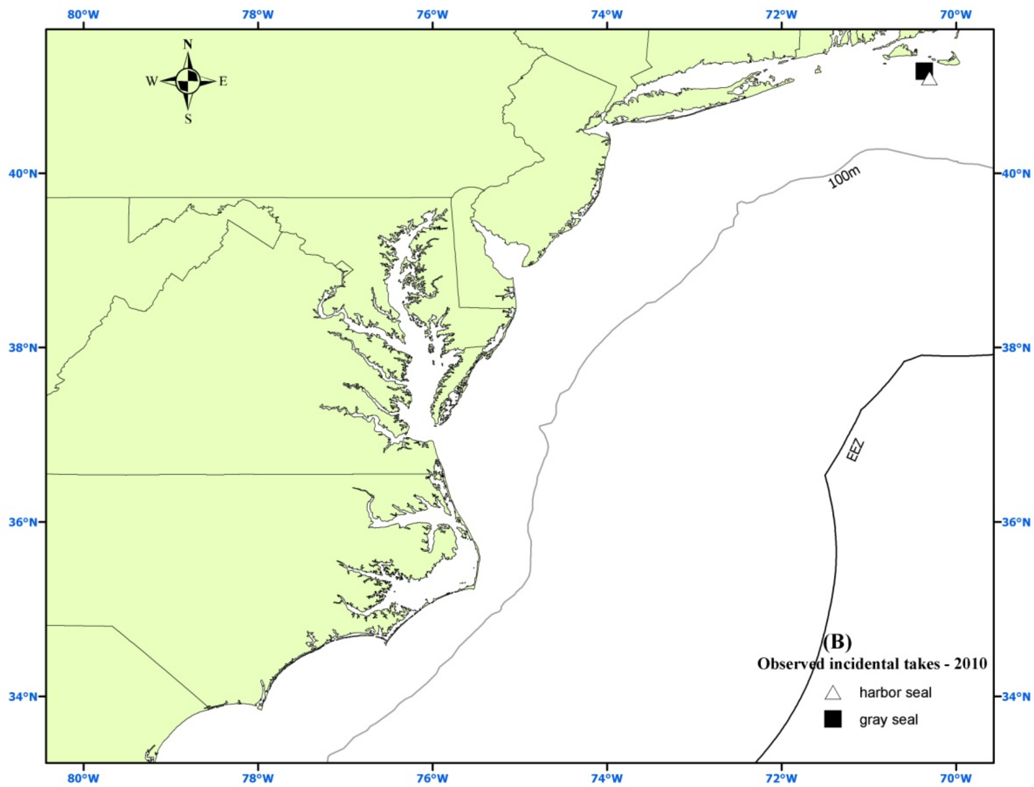
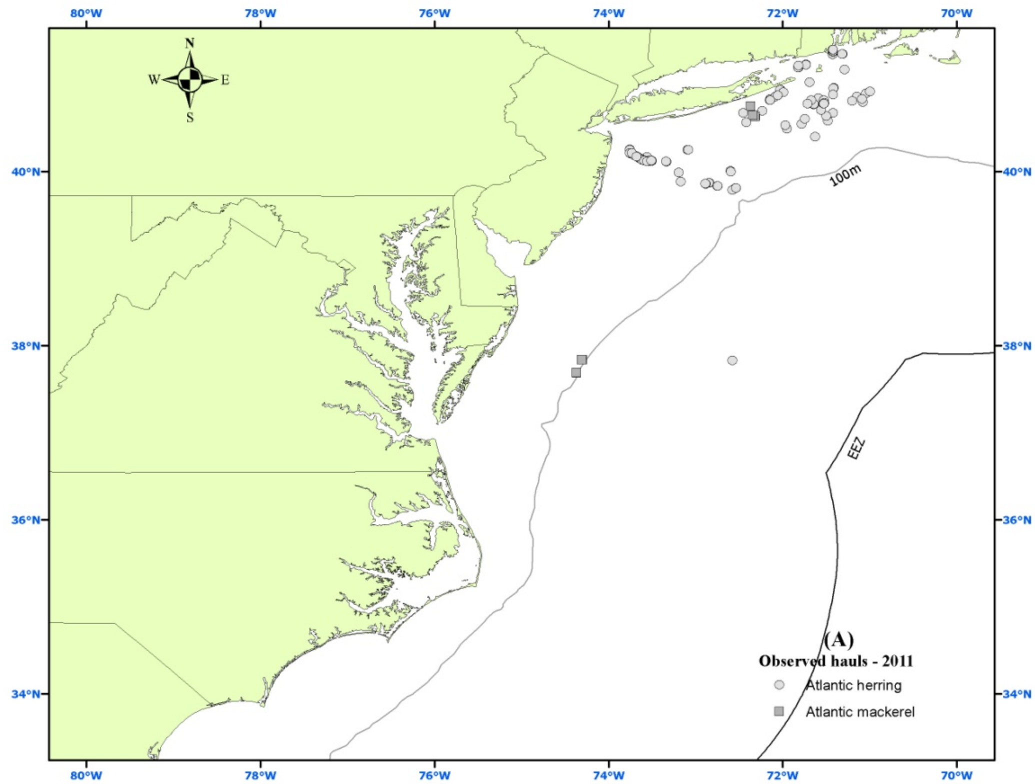



Figure 27. 2011 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).



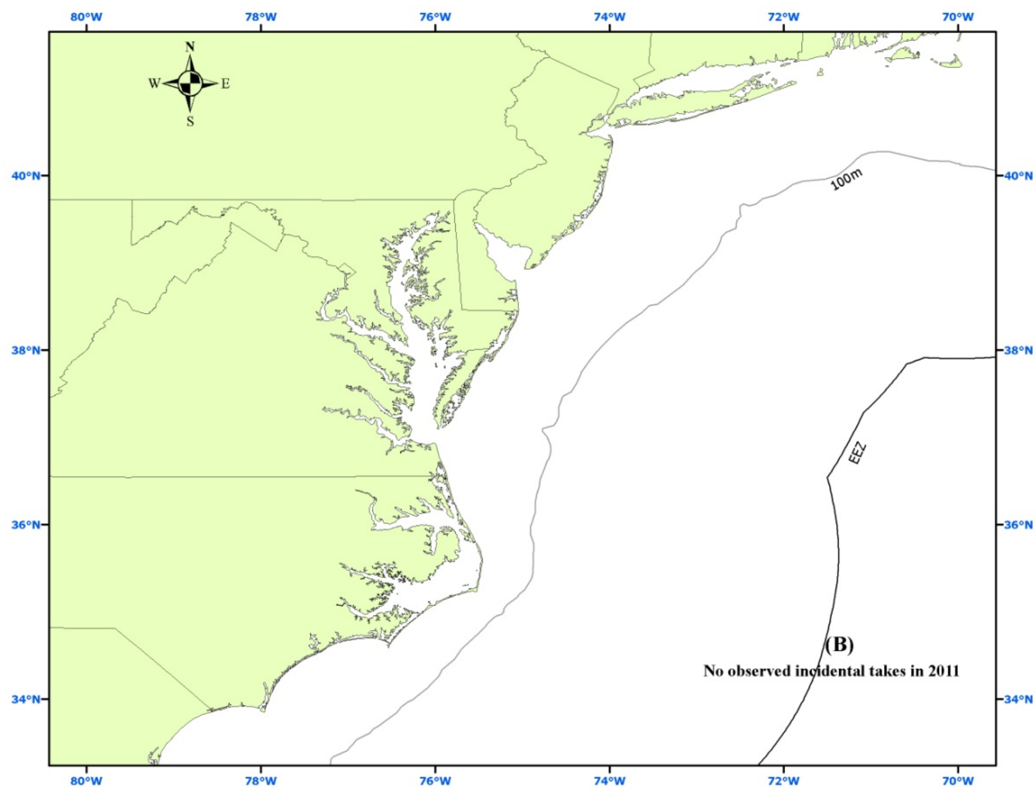



Figure 28. 2012 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

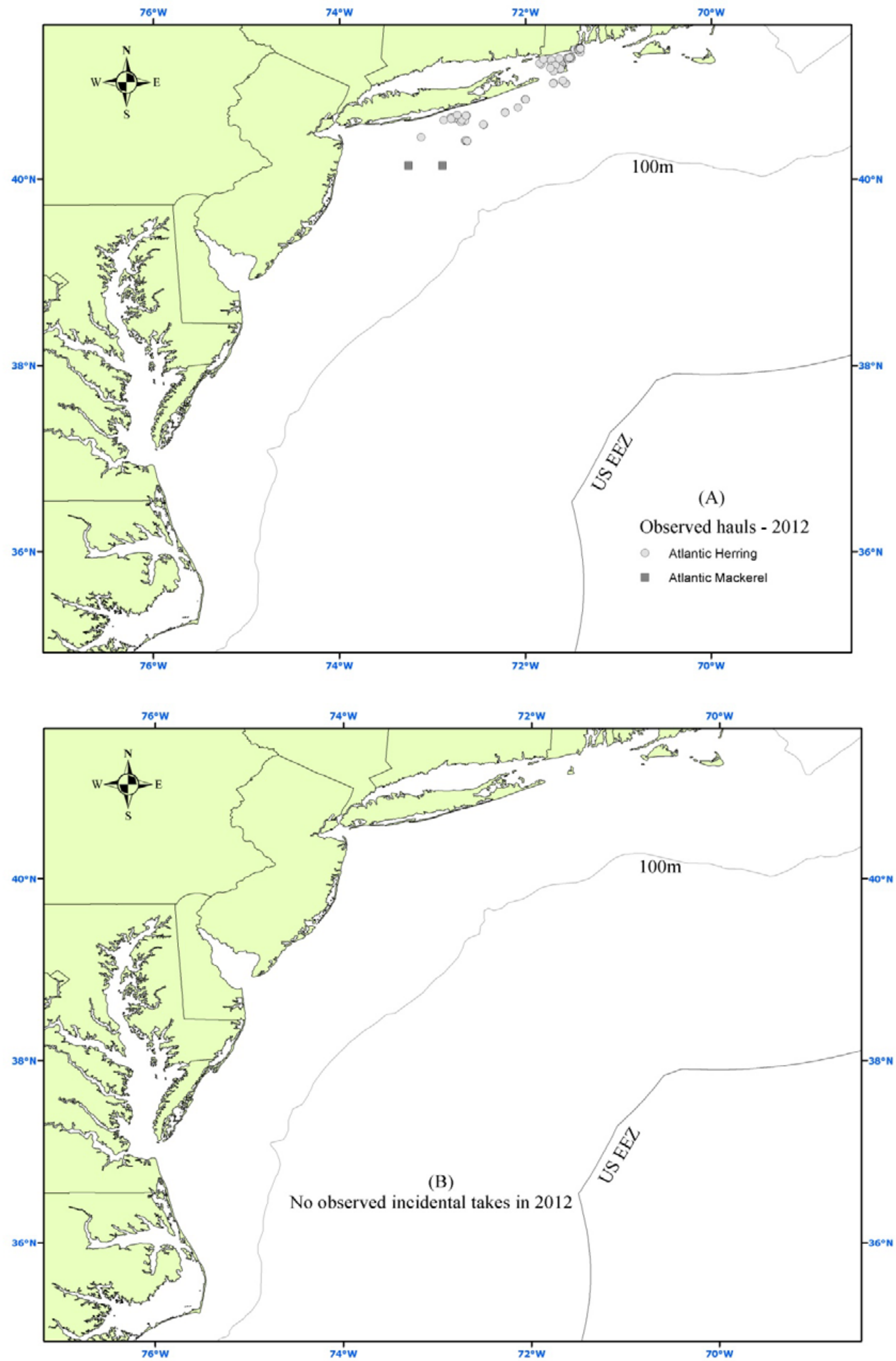
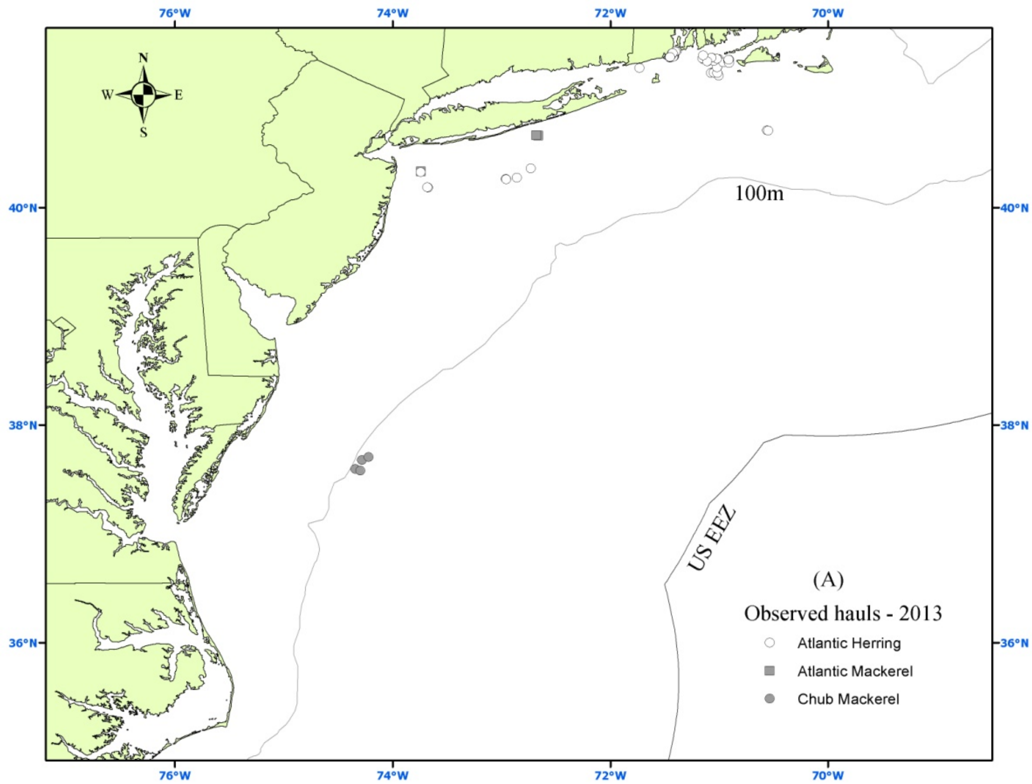


Figure 29. 2013 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).



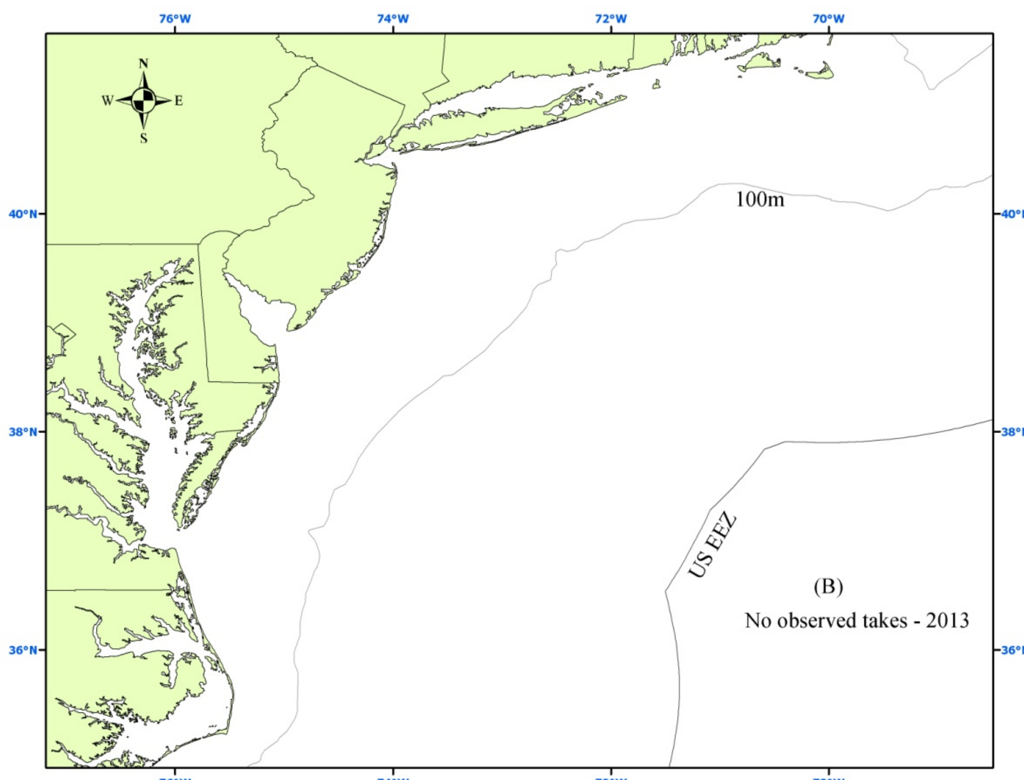
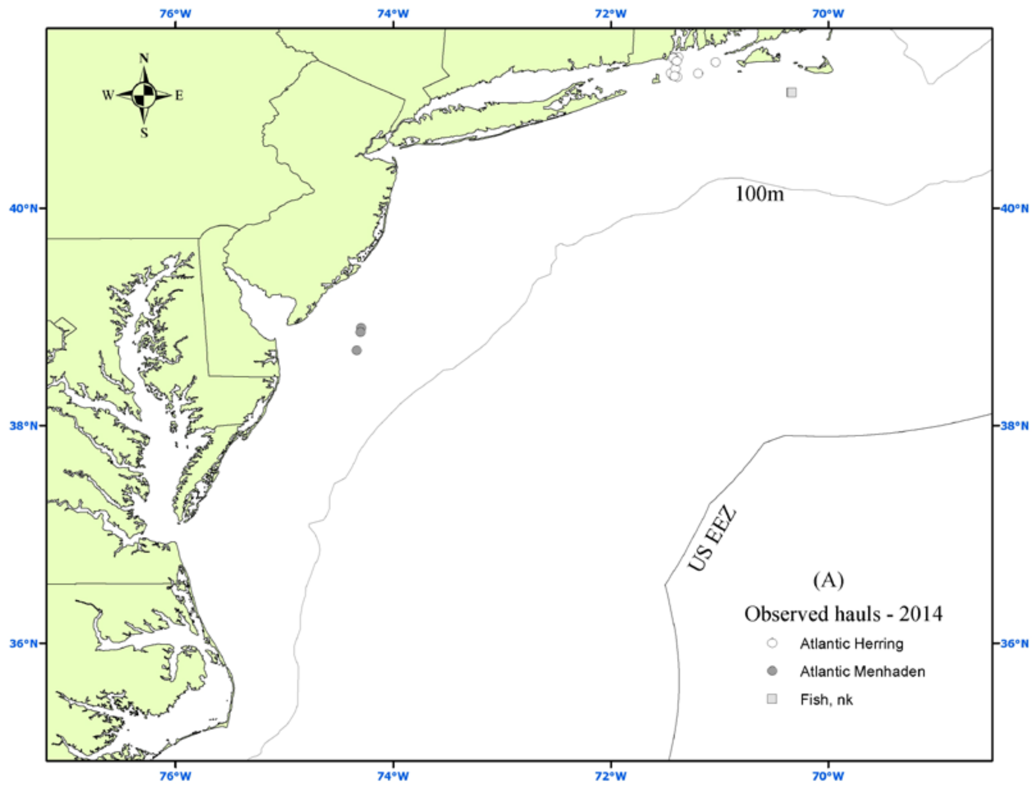



Figure 30. 2014 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).



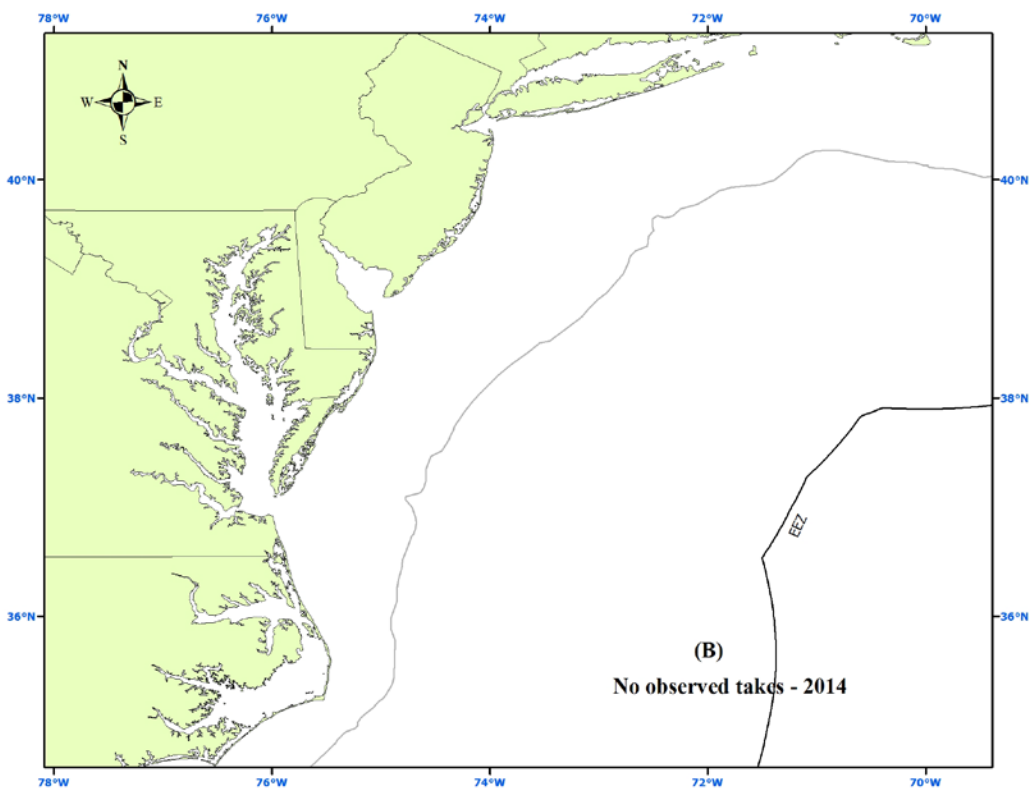



Figure 31. 2010 Herring Purse Seine observed hauls (A) and observed takes (B).

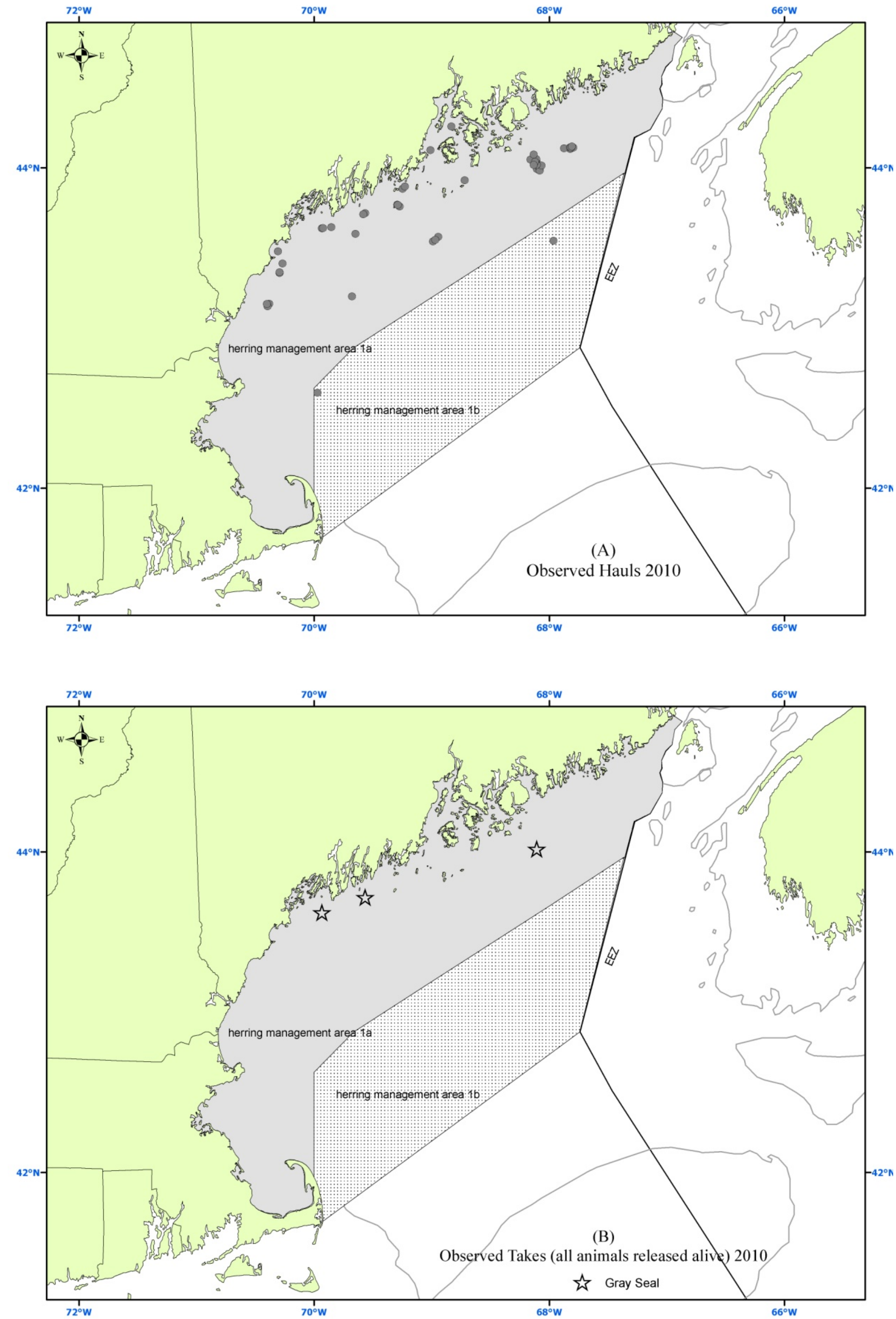
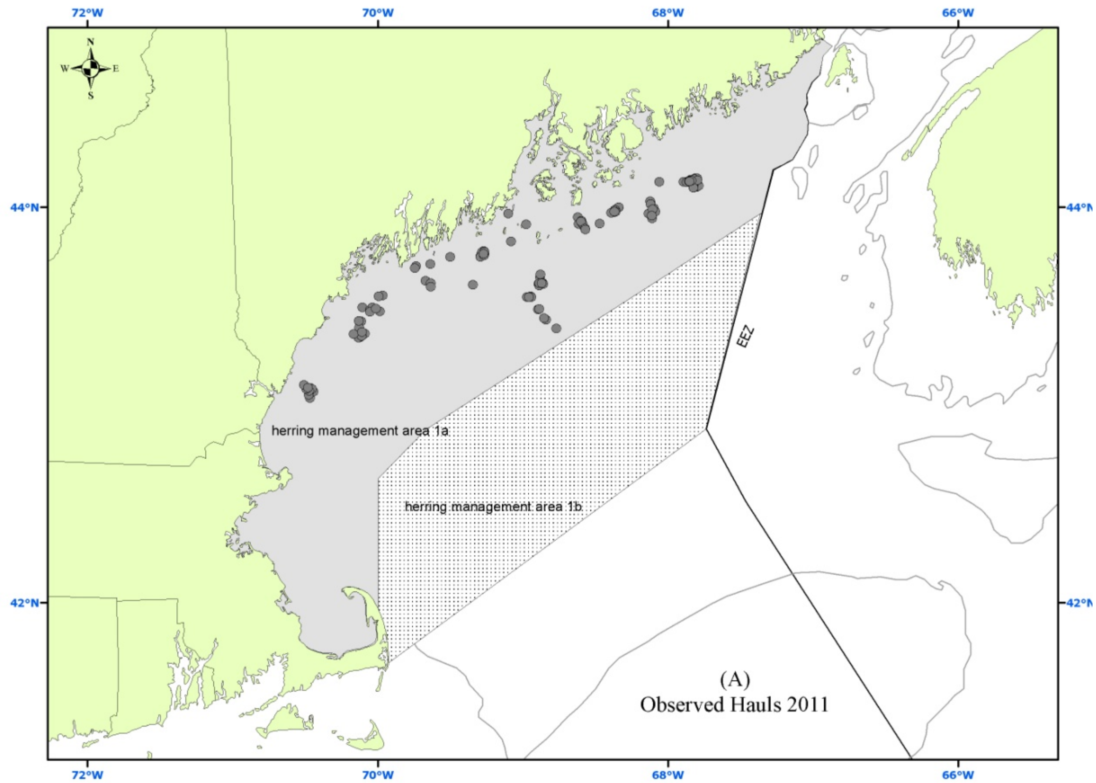


Figure 32. 2011 Herring Purse Seine observed hauls (A) and observed takes (B).



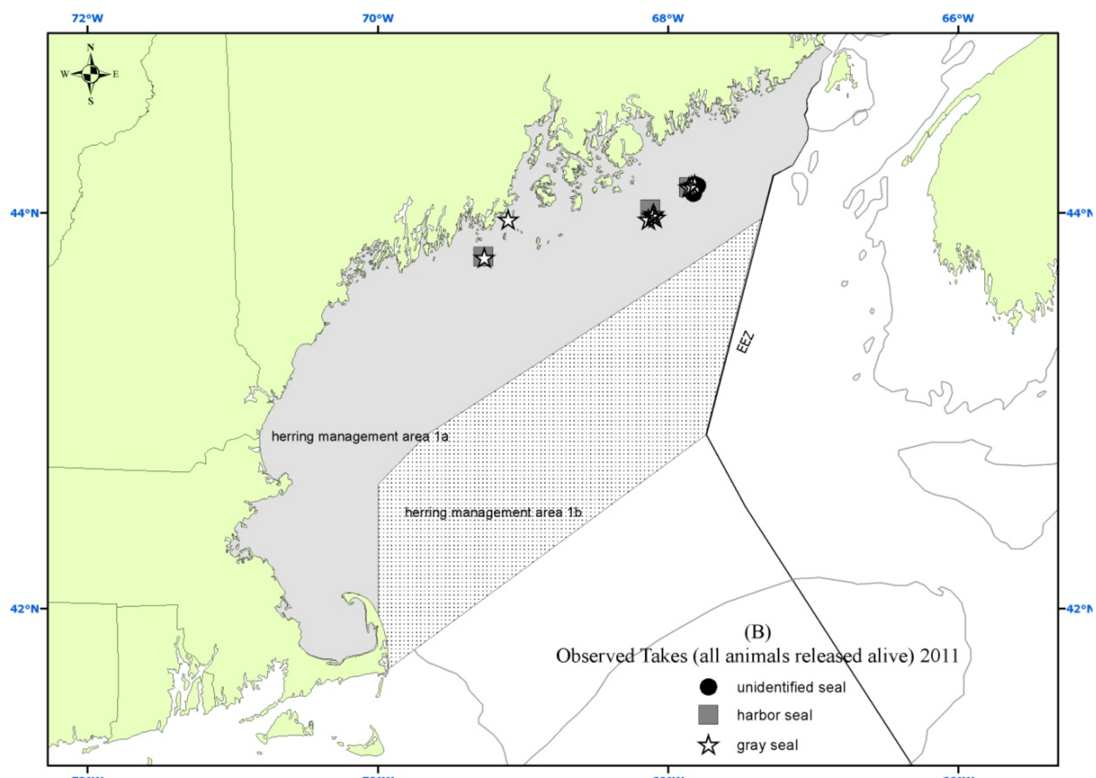



Figure 33. 2012 Herring Purse Seine observed hauls (A) and observed takes (B).

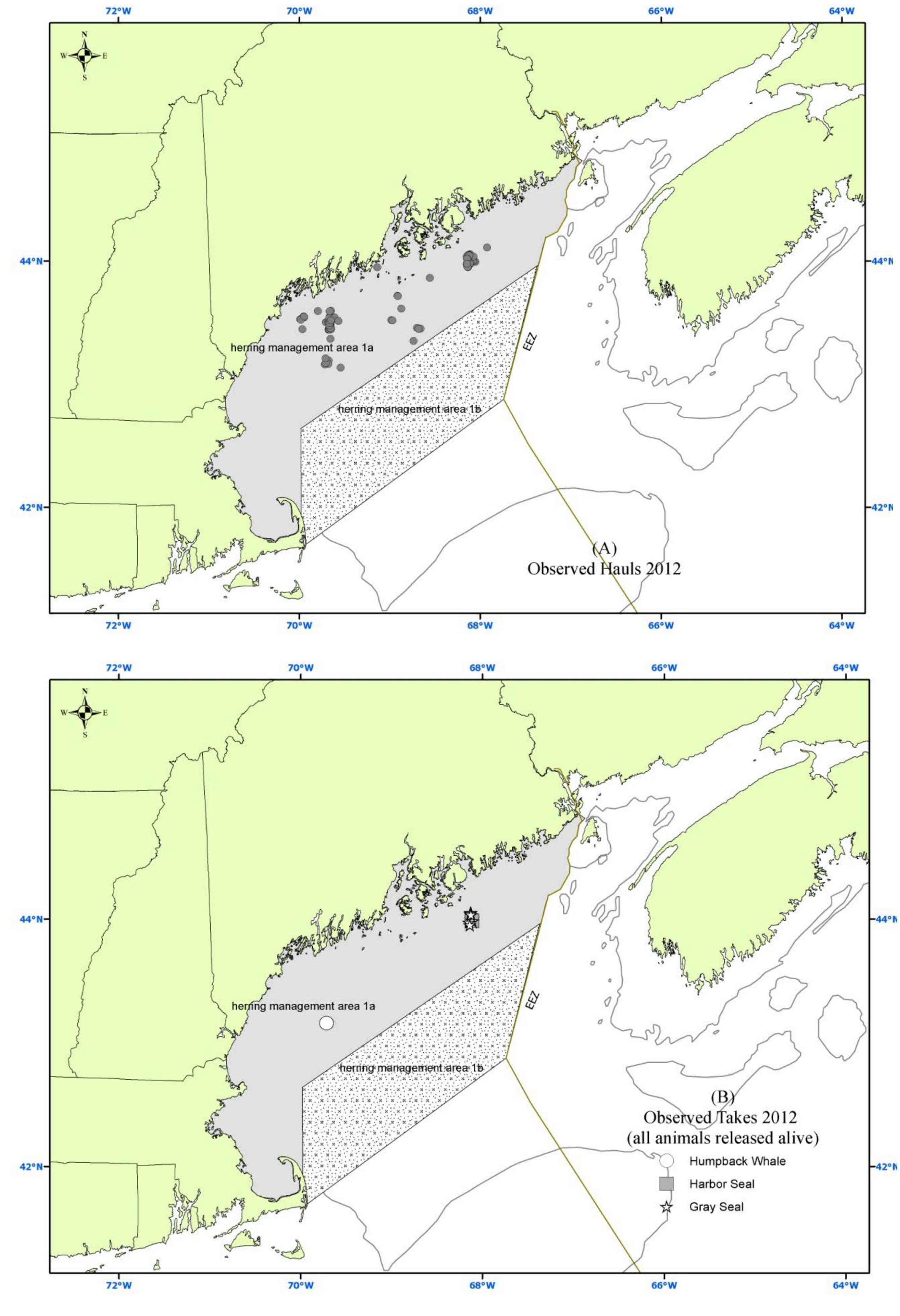


Figure 34. 2013 Herring Purse Seine observed hauls (A) and observed takes (B).

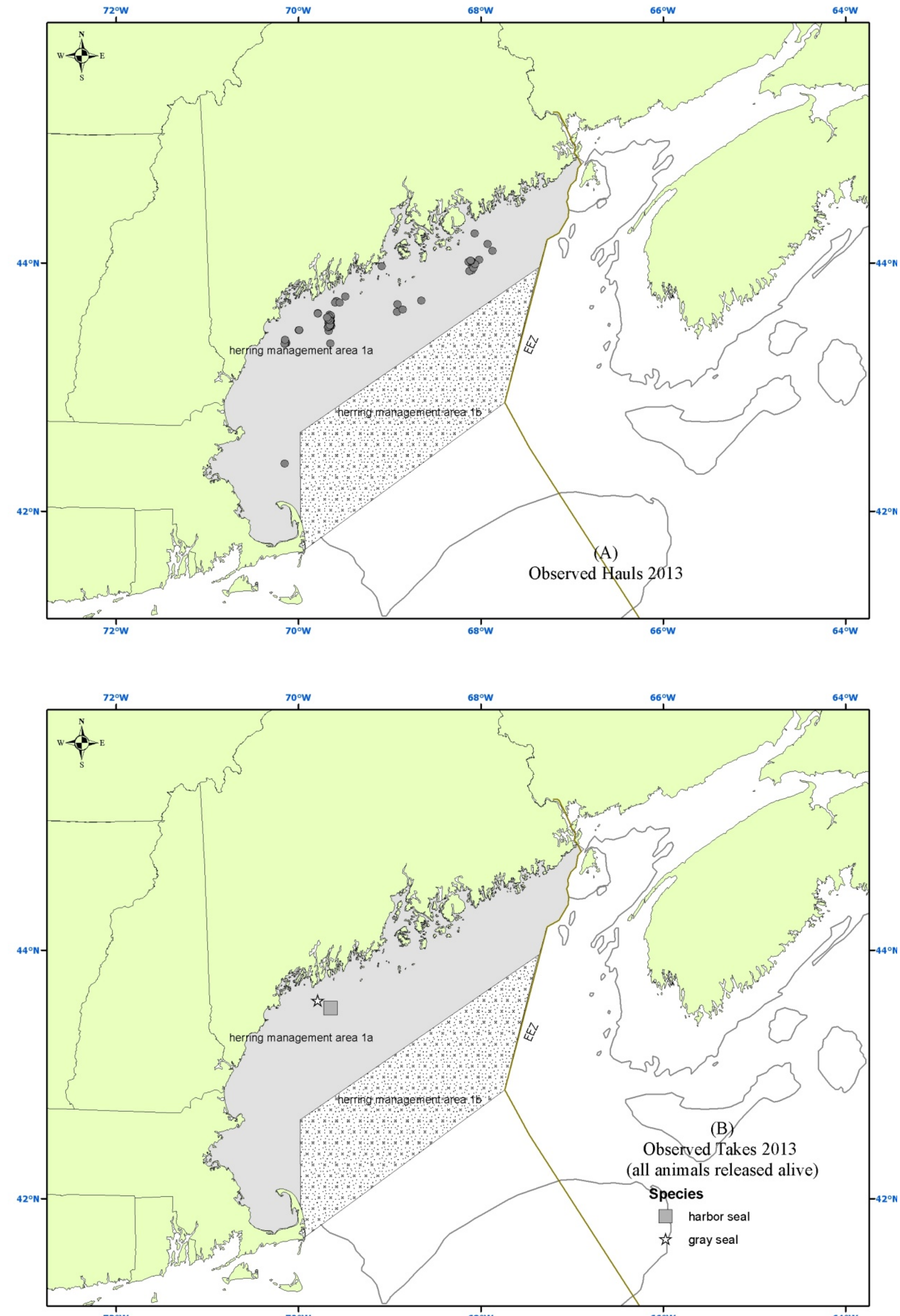


Figure 35. 2014 Herring Purse Seine observed hauls (A) and observed takes (B).

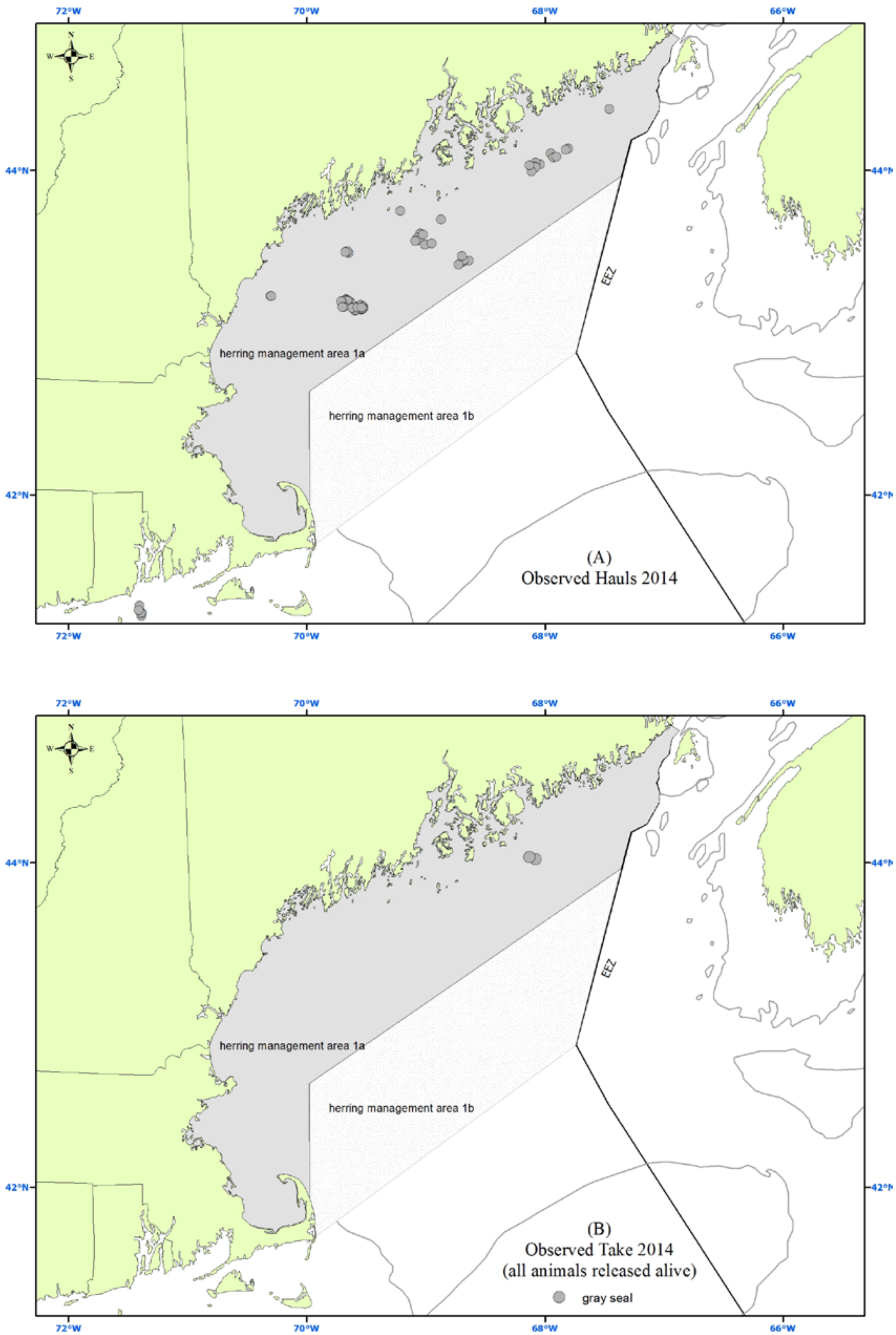


**Figure 36.** Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2010. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

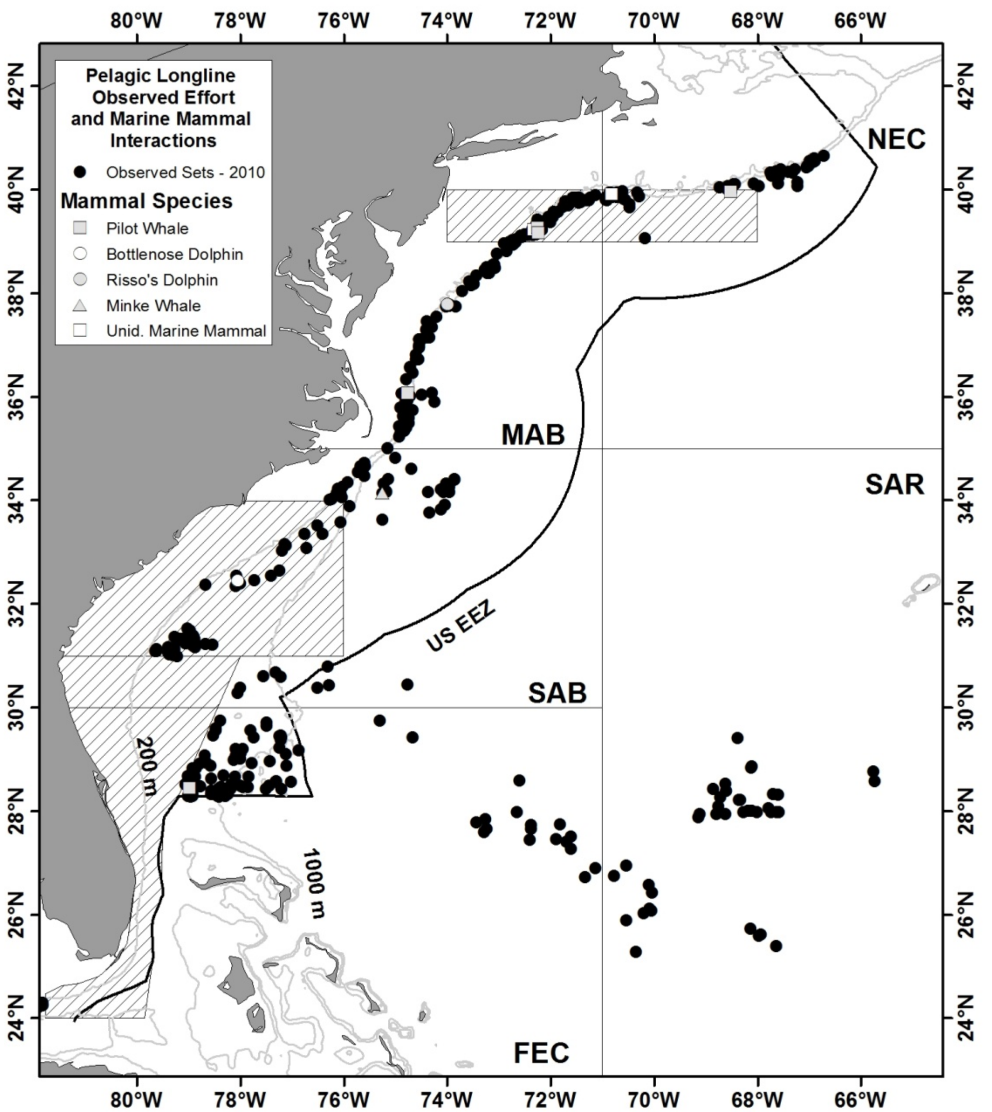


**Figure 37.** Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2011. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

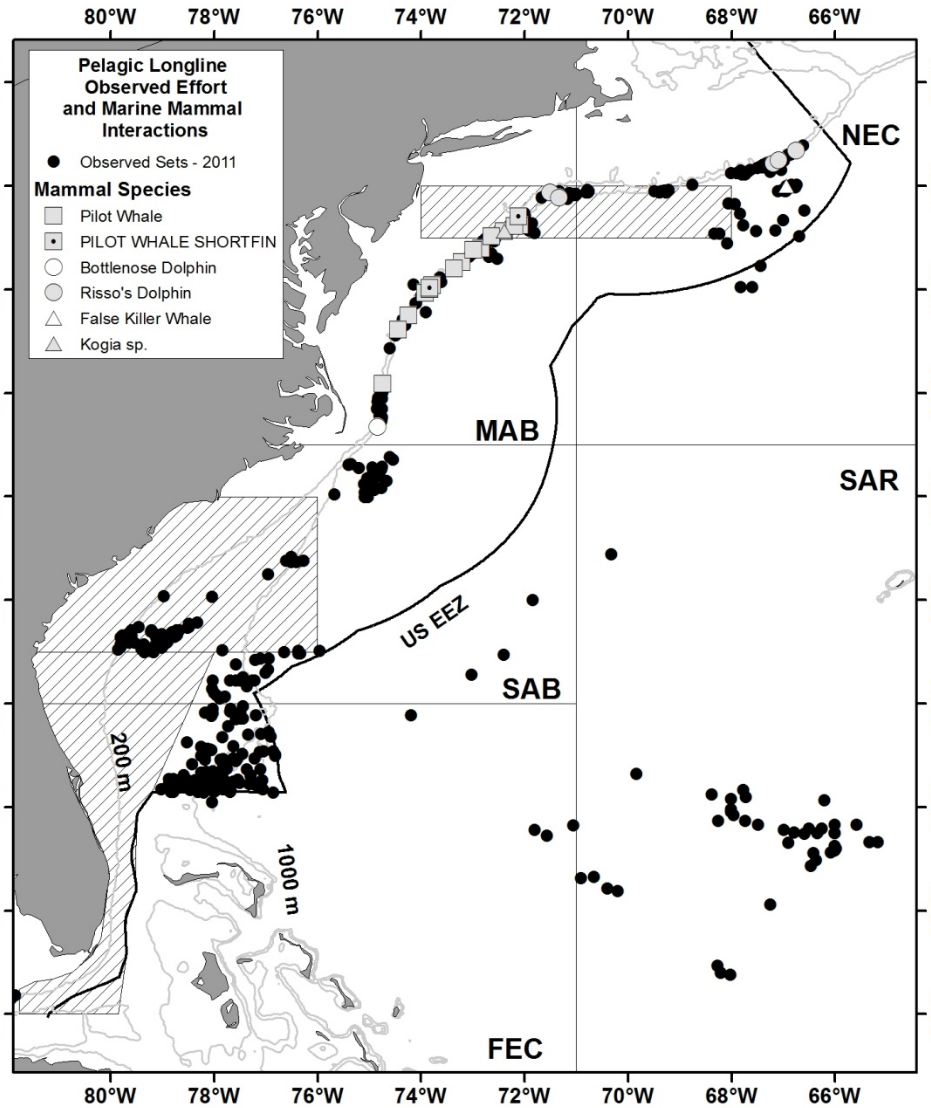


**Figure 38.** Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2012. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

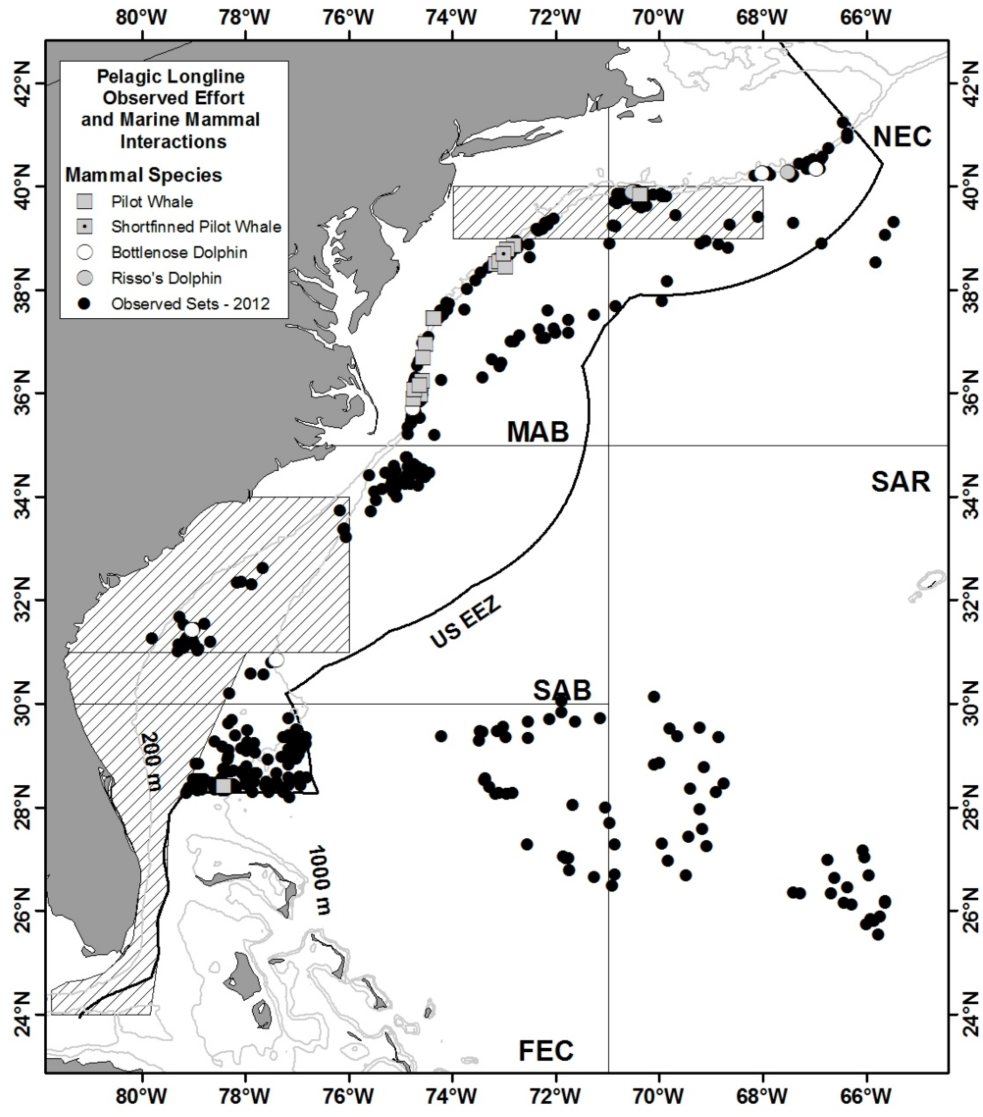


**Figure 39.** Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2013. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

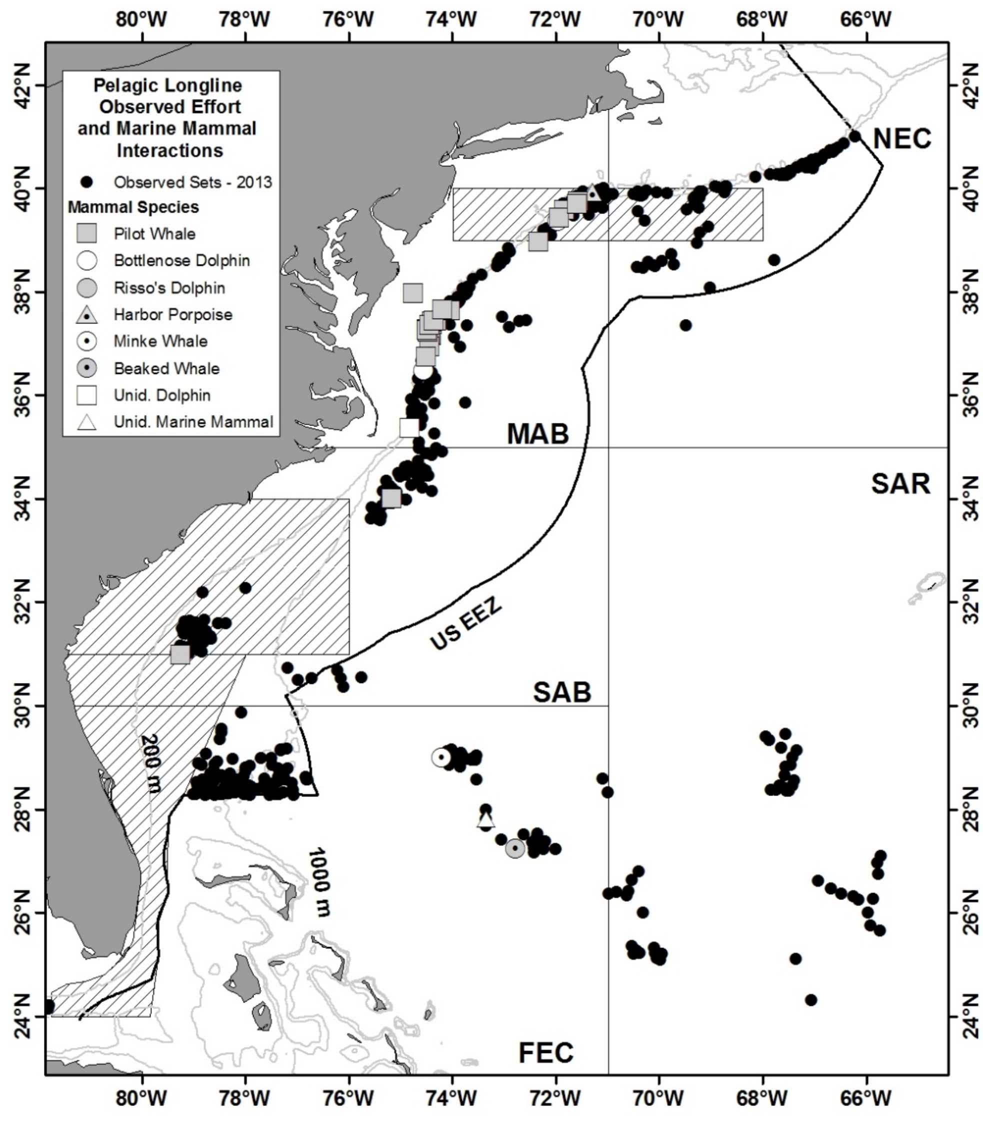


**Figure 40.** Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2014. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

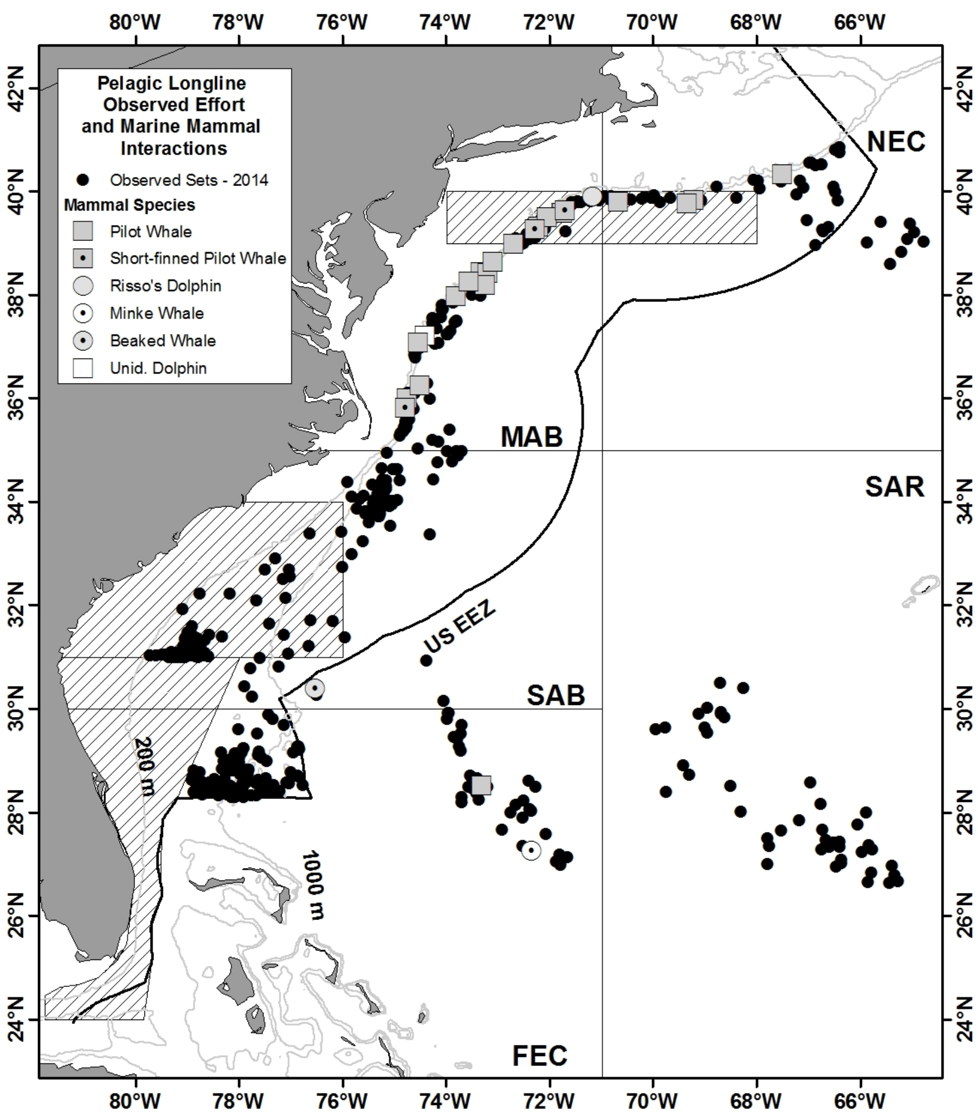


**Figure 41.** Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2010. Closed areas in the DeSoto canyon instituted in 2010 are shown as hatched areas.

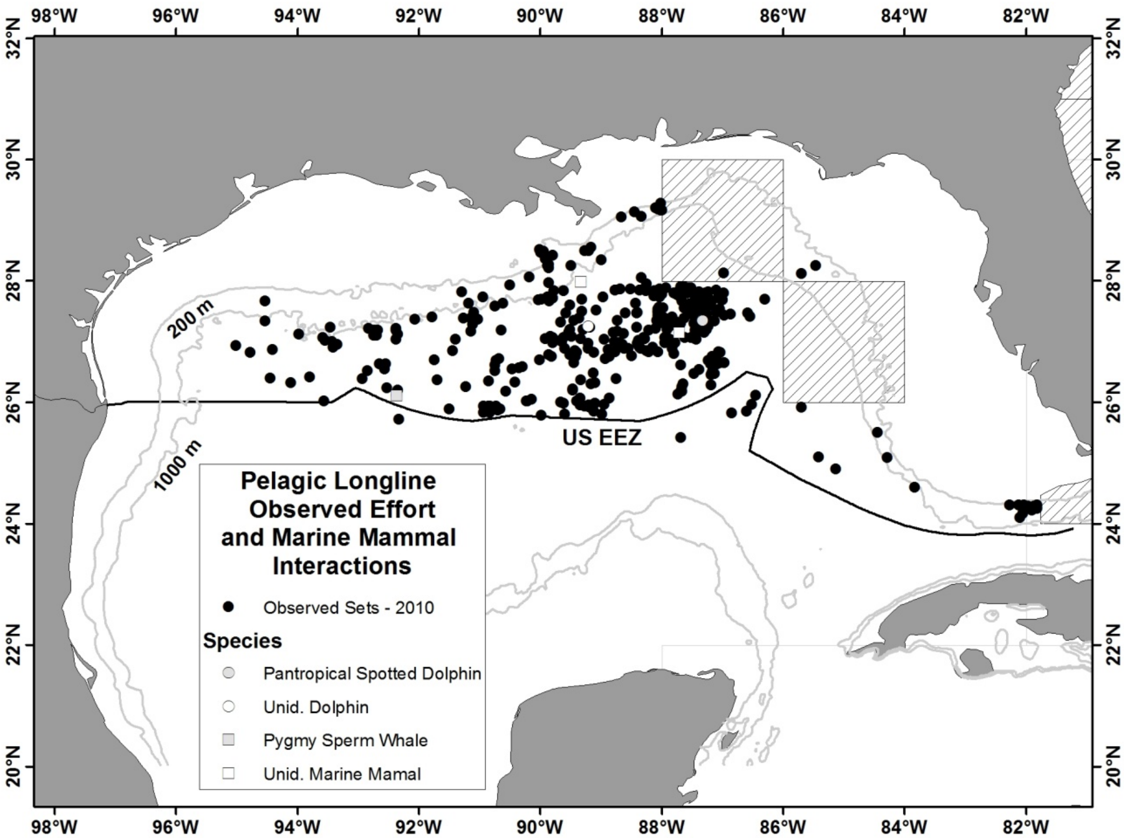


**Figure 42.** Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2011. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

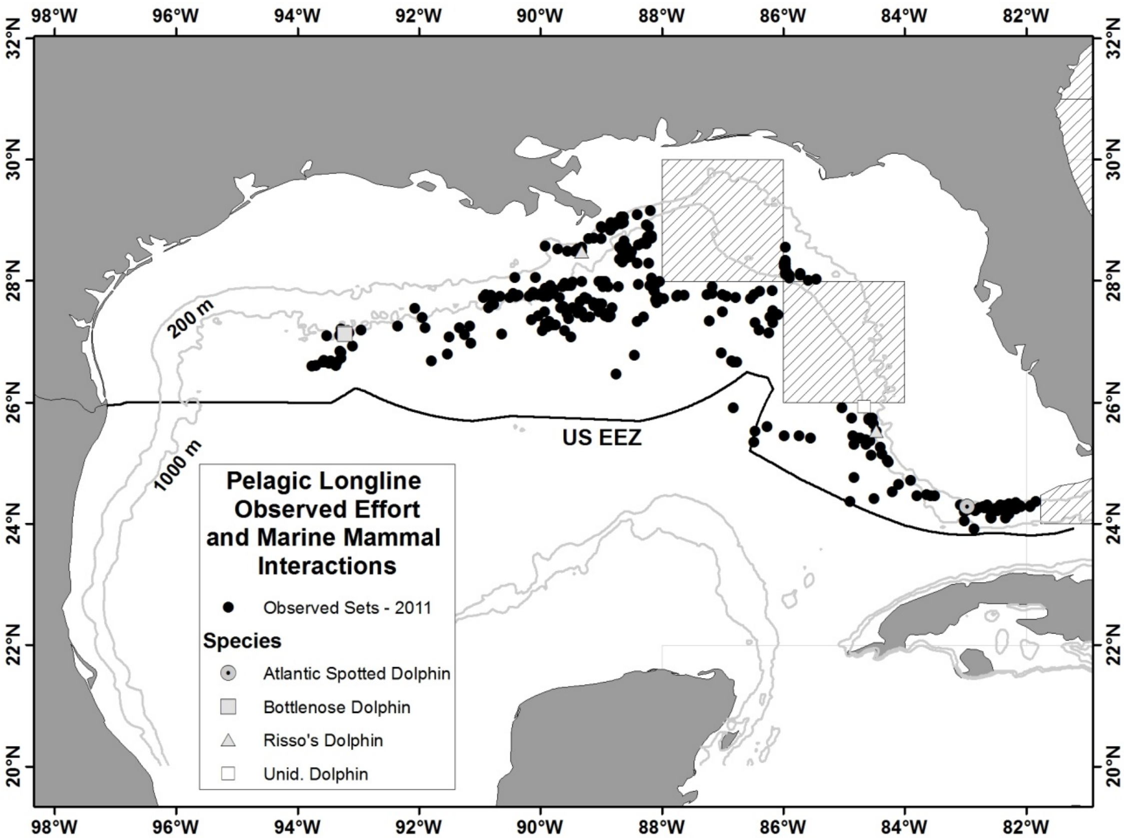


**Figure 43.** Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2012. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

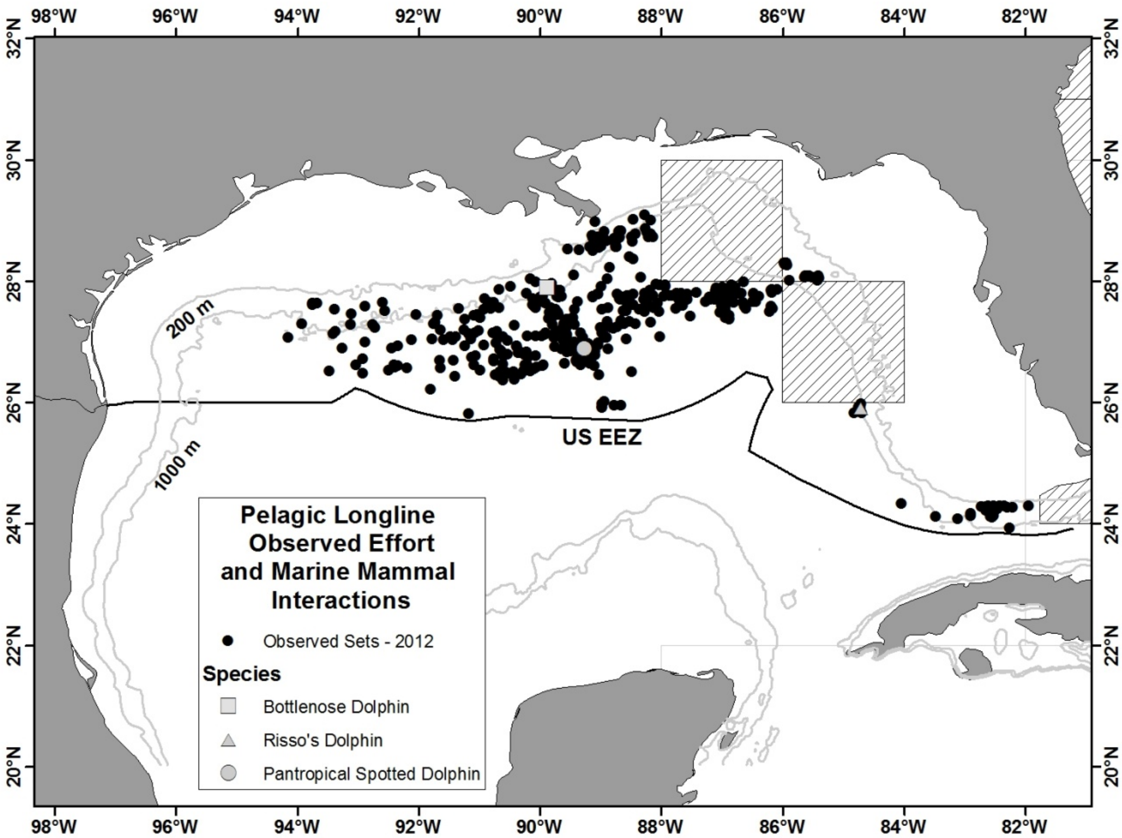


**Figure 44.** Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2013. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

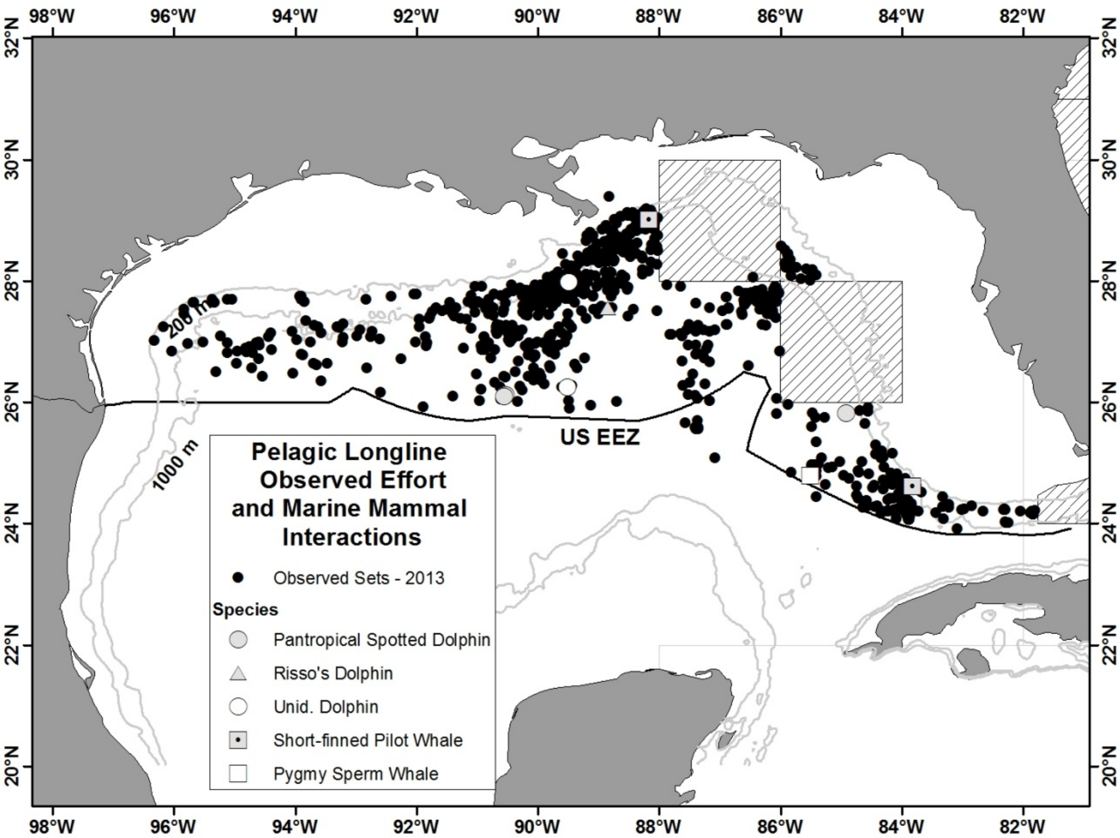
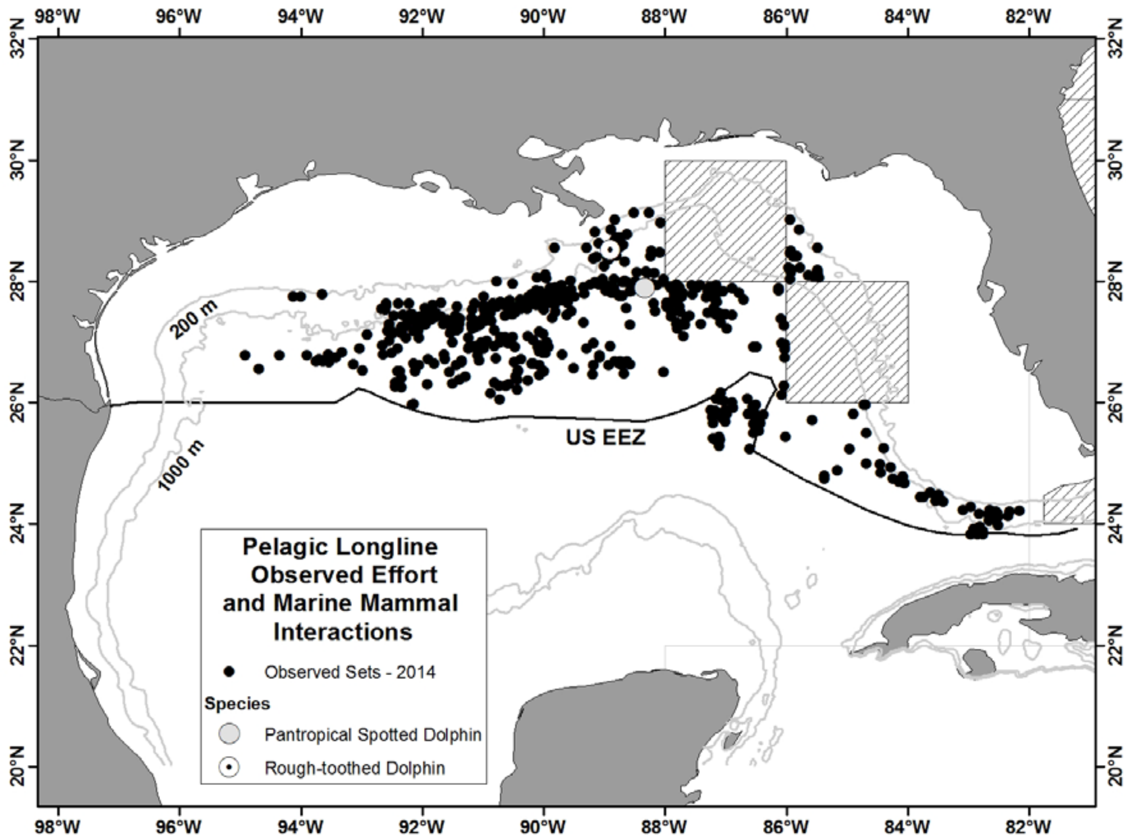


**Figure 45.** Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2014. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.



## Appendix IV

## Surveys and Abundance Estimates

| APPENDIX IV: Table A. Surveys | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Survey Number | Year | Season | Platform | Track line length (km) | Area | Agency / Program | Analysis | Corrected for g(0) | Reference |
| 1 | 1982 | year-round | plane | 211,585 | Cape Hatteras, NC to Nova Scotia, continental shelf and 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 the 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 and 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 and 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 and 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 and 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 | shelf edge and slope waters of Georges Bank | 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 procedure that modeled the left truncated sighting curve | N | Kingsley and Reeves 1998 |
| 12 | 1995 | Jul-Sep | 2 ships (Abel-J and Pelican) and 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 |
| 13 | 1996 | Jul-Aug | plane | 3,993 | Northern Gulf of St. Lawrence | DFO | Quenouille's jackknife bias reduction procedure 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 (1995 and 1998) | | Gulf of St. Lawrence | DFO | | | Kingsley and Reeves 1998 |
| 16 | 1998 | Jul-Sep | ship (Abel-J) and plane (Twin Otter) | 15,900 | north of Maryland | NEC | Ship: two independent team data analyzed with the modifed 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) and 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 - 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) and 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) and 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 | Canadian waters from Nova Scotia to Newfoundland | DFO | uncorrected counts | N | Lawson and Gosselin 2009 |
| 26 | 2008 | Aug | plane (Twin Otter) | 6,267 | NY to Maine in US waters | 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 |
| 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 Mexico bays and sounds, coastal waters from shoreline to 18-m isobath, and OCS waters from 18-m isobath to 9.3 km past the 18-m 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 Mexico from 200 m 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 Mexico bays and sounds, coastal waters from shoreline to 18-m isobath, and OCS waters from 18-m isobath to 9.3 km past the 18-m isobath | GOMEX92, GOMEX93 | One team data analyzed by DISTANCE | N | Blaylock and Hoggard 1994 |
| 33 | 1996-1997,1999-2001 | Apr-Jun | ship (Oregon II and Gunter) | 12,162 | northern Gulf of Mexico from 200 m to U.S. EEZ | SEC | One team data analyzed by DISTANCE | N | Mullin and Fulling 2004 |
| 34 | 1998-2001 | end Aug-early Oct | ship (Gunter and Oregon II) | 2,196 | northern Gulf of Mexico outer continental shelf (OCS, 20-200 m) | SEC | One team data analyzed by DISTANCE | N | Fulling et al. 2003 |
| 36 | 2004 | 12-13 Jan | helicopter | | Sable Island | DFO | Pup count | na | Bowen et al. 2007 |
| 37 | 2004 | | plane | | Gulf of St Lawrence and Nova Scotia Eastern Shore | DFO | Pup count | na | Hammill 2005 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 38 | 2009 | 10 Jun-13 Aug | ship | 4,600 | northern Gulf of Mexico from 200m to U.S. EEZ | SEC | One team data analyzed by DISTANCE | | |
| 39 | 2007 | 17 Jul-8 Aug | plane | | northern Gulf of Mexico from shore to 200m(majority of effort 0- 20m) | SEC | One team data analyzed by DISTANCE | | |
| 40 | 2011 | 4 Jun-1 Aug | ship (Bigelow) | 3,107 | Virginia to Massachusetts (waters that were deeper than the 100-m 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 | 7-26 Aug | Plane (Twin Otter) | 5,313 | Massachusetts to New Brunswick, Canada (waters north of New Jersey and shallower than the 100-m depth contour, through the US and Canadian Gulf of Maine and up to and including the lower Bay of Fundy) | 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 |
| 42 | 2011 | 19 Jun- 1 Aug | 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 | |
| 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 | 24 July–14 Aug | plane | 7,944 | southeastern Florida to Cape May, New Jersey | SEC | Two-independent teams, both using naked eye in the same plane. | | |
| 46 | 2011 | 6 –29 July | plane | 8,665 | southeastern Florida to Cape May, New Jersey | SEC | Two-independent teams, both using naked eye in the same plane. | | |

**APPENDIX IV: Table B. Abundance estimates – "Survey Number" refers to surveys described in Table A. "Best" estimate for each species in bold font .**

| Species | Stock | Year | Nbest | CV | Survey Number | Notes |
|---|---|---|---|---|---|---|
| Humpback Whale | Gulf of Maine | 1992 | 501 | | | minimum pop'n size estimated from photo-ID data |
| | | 1993 | 652 | 0.29 | | YONAH sampling (Clapham *et al.* 2003) |
| | | 1997 | 497 | | | minimum pop'n 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 |
| 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 |
| 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 |
| 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 |
| Sperm Whale | North Atlantic | 1982 | 219 | 0.36 | 1 | CETAP 1982 |
| | | 1990 | 338 | 0.31 | 2 | |
| | | 1991 | 736 | 0.33 | 7 | Waring *et al.*1992:1998 |
| | | 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 |
| 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 |
| 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.*1992:1998 |
| | | 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 |
| 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 |
| Risso's Dolphin | Western North Atlantic | 1982 | 4,980 | 0.34 | 1 | CETAP 1982 |
| | | 1991 | 11,017 | 0.58 | 7 | Waring *et al.*1992:1998 |
| | | 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 |
| 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.*1992:1998 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 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 |
| | | 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 | Lawson and Gosselin 2009; long-finned pilot whales |
| | | **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** |
| 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 |
| 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) |
| | | **2006** | **2,003** | **0.94** | **23** | |
| | | 2007 | 11,842 | | 25 | |
| | | 2008 | | | 26 | |
| Common Dolphin | Western North Atlantic | 1982 | 29,610 | 0.39 | 1 | |
| | | 1991 | 22,215 | 0.4 | 7 | Waring *et al.*1992:1998 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 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 |
| 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 |
| Pantropical Spotted Dolphin | Western North Atlantic | 1982 | 6,107 | 0.27 | 1 | CETAP 1982 |
| | | 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** |
| 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** |
| 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** |
| 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 | Palka 2006; survey discovered portions of the range not previously surveyed |
| | | 2002 | 64,047 | 0.48 | 21 | Palka 2006 |
| | | 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 |
| Harbor Seal | Western North Atlantic | 2001 | 99,340 | 0.097 | 27 | Gilbert *et al.* 2005 |
| | | | | | | Waring *et al.* 2015 |
| | | 2012 | 70,142 | 0.29 | 43 | |
| 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 |
| | | | 208,720 | 0.14 | | |
| | | | 216,490 | 0.11 | | |
| | | 2004 | 223,220 | 0.08 | 36 | Sable Island |
| | | | | 95% CI | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 2012 | 331,000 | 263,000-458,000 | | DFO 2013 |
| Bryde's Whale | Northern Gulf of Mexico | 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** | |
| Sperm Whale | Northern Gulf of Mexico | 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** | |
| Kogia spp. | Northern Gulf of Mexico | 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** | |
| Cuvier's Beaked Whale | Northern Gulf of Mexico | 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 | |
| | | **2009** | **74** | **1.04** | **38** | |
| Mesoplodon spp. | Northern Gulf of Mexico | 1996-2001 | 106 | 0.41 | 33 | Mullin and Fulling 2004 |
| | | 2003-2004 | 57 | 1.4 | 35 | |
| | | **2009** | **149** | **0.91** | **38** | |
| Killer Whale | Northern Gulf of Mexico | 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** | |
| False killer Whale | Northern Gulf of Mexico | 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 | |
| | | | | | | |
| Short-finned Pilot Whale | Northern Gulf of Mexico | 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** | |
| Melon-headed Whale | Northern Gulf of Mexico | 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** | |
| Pygmy Killer Whale | Northern Gulf of Mexico | 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** | |
| Risso's Dolphin | Northern Gulf of Mexico | 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** | |
| Pantropical Spotted Dolphin | Northern Gulf of Mexico | 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** | |
| Striped Dolphin | Northern Gulf of Mexico | 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** | |
| Spinner Dolphin | Northern Gulf of Mexico | 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** | |
| Clymene Dolphin | Northern Gulf of Mexico | 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** | |
| Atlantic Spotted Dolphin | Northern Gulf of Mexico | 1991-1994 oceanic | 3,213 | 0.44 | 30 | Hansen *et al*. 1995 |
| | | 1996-2001 oceanic | 175 | 0.84 | 33 | Mullin and Fulling 2004 |
| | | 1998-2001 OCS | 37,611 | 0.28 | 34 | This 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. |
| | | 2003-2004 oceanic | 0 | - | 35 | |
| | | 2009 | 2968 | 0.67 | 38 | |
| Fraser's Dolphin | Northern Gulf of Mexico | 1991-1994 | 127 | 0.9 | 30 | Hansen *et al*. 1995 |
| | | 1996-2001 | 726 | 0.7 | 33 | |
| | | 2003-2004 | 0 | - | 35 | |
| | | 2009 | 0 | - | 38 | Current best population size estimate is unknown. |
| Rough-toothed Dolphin | Northern Gulf of Mexico | 1991-1994 oceanic | 852 | 0.31 | 30 | |
| | | 1996-2001 oceanic | 985 | 0.44 | 33 | Mullin and Fulling 2004 |
| | | 1998-2001 OCS | 1,145 | 0.83 | 34 | This 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. |
| | | 2003-2004 oceanic | 1,508 | 0.39 | 35 | |
| | | 2009 | 624 | 0.99 | 0.05 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Bottlenose Dolphin | Northern Gulf of Mexico Oceanic | | | | | Mullin and Fulling 2004 |
| | | 1996-2001 | 2,239 | 0.41 | 33 | |
| | | | | | | |
| | | 2003-2004 | 3,708 | 0.42 | 35 | |
| | | | | | | |
| | | **2009** | **5,806** | **0.39** | **38** | |
| Bottlenose Dolphin | Northern Gulf of Mexico Continental Shelf | 1998-2001 | 17,777 | 0.32 | 34 | This 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. |
| Bottlenose Dolphin | Northern Gulf of Mexico Coastal (3 stocks) | Eastern 1994 | 9,912 | 0.12 | 32 | |
| | | Eastern 2007 | **7,702** | **0.19** | **39** | |
| | | Northern 1993 | 4,191 | 0.21 | 31 | Blaylock and Hoggard 1994; Current best population size estimate for this stock is unknown because data are more than 8 years old. |
| | | Northern 2007 | **2,473** | **0.25** | **39** | |
| | | Western 1992 | 3,499 | 0.21 | 31 | Blaylock and Hoggard 1994; Current best population size estimate for this stock is unknown because data are more than 8 years old. |
| Bottlenose Dolphin | Northern Gulf of Mexico Bay, Sound and Estuarine (33 stocks) | Choctawhatchee Bay, 2007 | 179 | 0.04 | | Conn *et al.* 2011 |
| | | St. Joseph Bay, 2005-2007 | 146 | 0.18 | | Balmer *et al.* 2008 |
| | | St. Vincent Sound, Apalachicola Bay, St. George Sound, 2008 | 439 | 0.14 | | Tyson *et al.* 2011 |
| | | Sarasota Bay, Little Sarasota Bay, 2007 | 160 | - | | Direct count; Wells 2009. |
| | | Mississippi River Delta, 2011-12 | 332 | .93 | | |
| | | Mississippi Sound/ Lake Borgne, Bay Boudreau | 901 | 0.63 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay (2006) | 826 | 0.09 | | Bassos-Hull *et al.* 2013 |
| | | Remaining 27 stocks | unknown | undetermined | 31 | Blaylock and Hoggard 1994; Current best population size estimate for each of these 27 stocks is unknown because data are more than 8 years old. |

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## 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 | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_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 | 0.82 | 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 |

Note: this table only includes observed bycatch. For a complete list of marine mamal species interactions with this fishery please see http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ne_sink_gillnet.html

[a] Unextrapolated mortalities

[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.

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 | | Bottlenose Dolphin, Northern Migratory Coastal Stock | | Bottlenose Dolphin, Southern Migratory Coastal Stock | | Bottlenose Dolphin, Northern NC Estuarine Stock | | Bottlenose Dolphin, Southern NC Estuarine Stock | | White-Sided Dolphin | | Common Dolphin | | Risso's Dolphin | | Pilot Whale, Unidentified | | Harbor Seal | | Gray Seal | | Harp Seal | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | SI&M_est | CV | SI&M_est | CV | SI&M_est (min-max)[b] | CV[b] | SI&M_est (min-max)[b] | CV[b] | SI&M_est (min-max)[b] | CV[b] | SI&M_est (min-max)[b] | CV[b] | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV |
| 1994 | 0 | 0 | 0 | 0 | na | na | na | na | na | na | na | na | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 103 | 0.57 | 56 | 1.66 | na | na | na | na | na | na | na | na | 0 | 0 | 7.4 | 0.69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 311 | 0.31 | 64 | 0.83 | na | na | na | na | na | na | na | na | 0 | 0 | 43 | 0.79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 572 | 0.35 | 0 | 0 | na | na | na | na | na | na | na | na | 45 | 0.82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 446 | 0.36 | 63 | 0.94 | na | na | na | na | na | na | na | na | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 11 | 0.77 | 0 | 0 | 17 | 1.02 |
| 1999 | 53 | 0.49 | 0 | 0 | na | na | na | na | na | na | na | na | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 21 | 0.76 | 0 | 0 | na | na | na | na | na | na | na | na | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 26 | 0.95 | na | na | na | na | na | na | na | na | na | na | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | unk | na | 0 | 0 | 8.25-9.29 | 0.34-0.33 | 11.96-30.68 | 0.79-0.52 | 5.21-24.38 | 0.63-0.53 | 0.59-1.45 | 0.35-0.30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 76 | 1.13 | 0 | 0 | 3.92-6.66 | 0.36-0.30 | 15.71-41.55 | 0.51-0.62 | 3.68-27.17 | 0.58-0.59 | 1.04-1.57 | 0.42-0.34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 137 | 0.91 | 0 | 0 | 4.86-7.28 | 0.35-0.33 | 33.50-40.10 | 0.79-0.51 | 4.03-18.96 | 0.62-0.49 | 0.92-2.17 | 0.43-0.36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0.86 | 69 | 0.92 | 0 | 0 |
| 2005 | 470 | 0.51 | 1[a] | na | 4.89-6.52 | 0.39-0.32 | 69.40-80.30 | 0.60-0.64 | 3.95-15.20 | 0.60-0.49 | 0.48-0.78 | 0.41-0.30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63 | 0.67 | 0 | 0 | 0 | 0 |
| 2006 | 511 | 0.32 | 0 | 0 | 4.64-5.19 | 0.33-0.33 | 4.00-79.50 | 0.48-0.53 | 2.16-35.55 | 0.35-0.49 | 0.75-1.05 | 0.51-0.37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 0.98 | 0 | 0 | 0 | 0 |
| 2007 | 58 | 1.03 | 0 | 0 | 0.00-3.18 | 0.00-1.08 | 0.00-6.00 | 0.00-0.97 | 0.00-9.69 | 0.00-0.95 | 0.00-0.00 | 0.00-0.00 | 0 | 0 | 0 | 0 | 34 | 0.73 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 0.9 |
| 2008 | 350 | 0.75 | 0 | 0 | 0.00-3.05 | 0.00-1.08 | 0.00-5.27 | 0.00-0.97 | 0.00-8.08 | 0.00-0.95 | 0.00-0.00 | 0.00-0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 88 | 0.74 | 0 | 0 | 176 | 0.74 |
| 2009 | 201 | 0.55 | 0 | 0 | 0.00-23.86 | 0.00-0.83 | 0.00-37.61 | 0.00-0.86 | 0.00-46.79 | 0.00-0.82 | 0.00-0.00 | 0.00-0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 0.68 | 0 | 0 | 0 | 0 |
| 2010 | 259 | 0.88 | 0 | 0 | 0.00-2.62 | 0.00-1.08 | 0.00-4.11 | 0.00-0.97 | 0.00-6.96 | 0.00-0.95 | 0.00-0.00 | 0.00-0.00 | 0 | 0 | 30 | 0.48 | 0 | 0 | 0 | 0 | 89 | 0.39 | 267 | 0.75 | 0 | 0 |
| 2011 | 123 | 0.41 | 0 | 0 | 0.00-2.98 | 0.00-1.08 | 0.00-4.33 | 0.00-0.97 | 0.00-8.38 | 0.00-0.95 | 0.00-0.00 | 0.00-0.00 | 0 | 0 | 29 | 0.53 | 0 | 0 | 0 | 0 | 21 | 0.67 | 19 | 0.6 | 0 | 0 |
| 2012 | 63.41 | 0.83 | 0 | 0 | tbd | tbd | tbd | tbd | tbd | tbd | tbd | tbd | 0 | 0 | 15 | 0.93 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0.98 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 | 19 | 1.06 | 26 | 0.95 | tbd | tbd | tbd | tbd | tbd | tbd | tbd | tbd | 0 | 0 | 62 | 0.67 | 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 |

Note: this table only includes observed bycatch. For a complete list of marine mamal species interactions with this fishery please see http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/midatl_gillnet.html

[a] Unextrapolated mortalities

[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.

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 | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | 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 | 0.3 | 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 | 0.3 | 0 | 0 | 0 | 0 | unk | unk | unk | unk | 0 | 0 |
| 2006 | 6.5 | 0.49 | 0 | 0 | 40 | 0.5 | 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 | 7.8 | 0.69 |
| 2009 | 0 | 0 | 18 | 0.92 | 171 | 0.28 | 24 | 0.6 | 3 | 0.53 | 0 | 0 | 13 | 0.7 | 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 | 25 | 0.44 | 11 | 0.63 | 19 | 0.45 | | | 0 | 0 |

Note: this table only includes observed bycatch. For a complete list of marine mamal species interactions with this fishery please see http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ne_bottom_trawl.html [a] Unextrapolated mortalities

[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.

na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

## Mid-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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV |
| 1997 | 0 | 0 | 0 | 0 | 161 | 1.58 | 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 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 228 | 1.03 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 27 | 0.17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 27 | 0.19 | 103 | 0.27 | 0 | 0 | 39 | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 25 | 0.17 | 87 | 0.27 | 0 | 0 | 38 | 0.36 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 31 | 0.25 | 99 | 0.28 | 0 | 0 | 31 | 0.31 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 26 | 0.2 | 159 | 0.3 | 0 | 0 | 35 | 0.33 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 38 | 0.29 | 141 | 0.29 | 0 | 0 | 31 | 0.31 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 3 | 0.53 | 131 | 0.28 | 0 | 0 | 37 | 0.34 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 11 | 0.42 | 2 | 1.03 | 66 | 0.27 | 33 | 0.34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0 | 16 | 0.36 | 0 | 0 | 23 | 1 | 39 | 0.69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 0 | 0 | 21 | 0.45 | 0 | 0 | 167 | 0.46 | 23 | 0.5 | 0 | 0 | 0 | 0 | 24 | 0.92 | 38 | 0.7 |
| 2010 | 0 | 0 | 20 | 0.34 | 0 | 0 | 21 | 0.96 | 54 | 0.74 | 0 | 0 | 0 | 0 | 11 | 1.1 | 0 | 0 |
| 2011 | 0 | 0 | 34 | 0.31 | 0 | 0 | 271 | 0.25 | 62 | 0.56 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 0.57 |
| 2012 | 0 | 0 | 16 | 1.00 | 0 | 0 | 323 | 0.26 | 8 | 1 | 0 | 0 | 0 | 0 | 23 | 1 | 30 | 1.1 |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 | 269 | 0.29 | 46 | 0.71 | 0 | 0 | 0 | 0 | 11 | 0.96 | 29 | 0.67 |
| 2014 | 0 | 0 | 25 | 0.66 | 9.7 | 0.94 | 329 | 0.29 | 21 | 0.93 | 0 | 0 | 0 | 0 | 10 | 0.95 | 7 | 0.96 |

Note: this table only includes observed bycatch. For a complete list of marine mamal species interactions with this fishery please see http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ma_bottom_trawl.html

[a] Unextrapolated mortalities

[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.

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

| | 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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.6 | 0.74 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | unk | na | 0 | 0 | 0 | 0 | 11 | 0.74 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | unk | na | 0 | 0 | 0 | 0 | 8.9 | 0.74 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 22 | 0.97 | 0 | 0 | 0 | 0 | 14 | 0.56 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.8 | 0.58 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 9.4 | 1.03 | 0 | 0 | 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 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 0.61 | 0 | 0 | 0 | 0 |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.3 | 0.81 | 0 | 0 |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 1[a] | na | 0 | 0 | 0 | 0 | 0 | 0 | 2[a] | na | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | 1[a] | na | 0 | 0 | 0 | 0 | 1 | 0 | 1[a] | na | 1[a] | na |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1[a] | na |
| 2014 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | na | 1[a] | na | 0 | 0 |

Note: this table only includes observed bycatch. For a complete list of marine mamal species interactions with this fishery please see http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ne_mw_trawl.html

[a] Unextrapolated mortalities

[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.

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 | | Pilot Whale, Unidentified | | Long-finned Pilot Whale | | Harbor Seal | | Gray Seal | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | unk | na | 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 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 22 | 0.99 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 58 | 1.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 29 | 0.74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 12 | 0.98 | 3.2 | 0.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 15 | 0.73 | 0 | 0 | 1[a] | na | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 4 | 0.92 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1[a] | na | 1[a] | na |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2014 | 0 | 0 | 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 mamal species interactions with this fishery please see http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ma_mw_trawl.html

[a] Unextrapolated mortalities

[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.

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 - Atl. | | Short-finned Pilot Whale - Atlantic | | Beaked whale, Unidentified | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | 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 | 0.732 | 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 | 11.8 | 0.699 | 1.5 | 1 | 0 | 0 | 305 | 0.29 | 0 | 0 |
| 2012 | 1 | 0 | 61.8 | 0.68 | 0 | 0 | 15.1 | 1 | 29.8 | 1 | 0 | 0 | 170.1 | 0.33 | 0 | 0 |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 | 1.9 | 1 | 0 | 0 | 0 | 0 | 124 | 0.32 | 0 | 0 |
| 2014 | 0 | 0 | 0 | 0 | 0 | 0 | 7.7 | 1 | 0 | 0 | 0 | 0 | 233 | 0.24 | 0 | 0 |

Note: this table only includes observed bycatch. For a complete list of marine mamal species interactions with this fishery please see http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/ao_car_gmex_pelagics_longline.html[a] Unextrapolated mortalities
[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.
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 | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_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.
[a] Unextrapolated mortalities
[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.
na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

**Pelagic Pair Trawl**

| | White-Sided Dolphin | | Common Dolphin | | Risso's Dolphin-Atlantic | | Pilot Whale, Unidentified | | Long-finned Pilot Whale | | Bottlenose dolphin-Atlantic offshore | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_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.

[a] Unextrapolated mortalities

[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.

na=not applicable; unk= observer coverage was absent or too low to detect bycatch, or no estimate generated; tbd= to be determined

## Gulf of Mexico 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 | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_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 |

Note: this table only includes observed bycatch. For a complete list of marine mammal species interactions with this fishery please see http://www.nmfs.noaa.gov/pr/interactions/fisheries/table2/segom_shrimp_trawl.html

[a] Unextrapolated mortalities

[b] Due to uncertainty in stock identification both minimum and maximum estimates are provide with associated CV's. As a result of uncertainty in stock identification, minimum and maximum mortality estimates are not additive across the Atlantic coastal and estuarine bottlenose dolphin stocks.

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 Gilllnet | | Pelagic Drift Gillnet | |
|---|---|---|---|---|---|---|---|---|
| **Year** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** |
| 1990 | na | na | 0 | 0 | 2900 | 0.32 | 1.7 | 2.65 |
| 1991 | na | na | 0 | 0 | 2000 | 0.35 | 0.7 | 1 |
| 1992 | na | na | 0 | 0 | 1200 | 0.21 | 0.4 | 1 |
| 1993 | na | na | 0 | 0 | 1400 | 0.18 | 1.5 | 0.34 |
| 1994 | na | na | 0 | 0 | 2100 | 0.18 | | |
| 1995 | 103 | 0.57 | 0 | 0 | 1400 | 0.27 | | |
| 1996 | 311 | 0.31 | 0 | 0 | 1200 | 0.25 | | |
| 1997 | 572 | 0.35 | 0 | 0 | 782 | 0.22 | | |
| 1998 | 446 | 0.36 | 0 | 0 | 332 | 0.46 | | |
| 1999 | 53 | 0.49 | 0 | 0 | 270 | 0.28 | | |
| 2000 | 21 | 0.76 | 0 | 0 | 507 | 0.37 | | |
| 2001 | 26 | 0.95 | 0 | 0 | 53 | 0.97 | | |
| 2002 | unk | na | 0 | 0 | 444 | 0.37 | | |
| 2003 | 76 | 1.13 | * | * | 592 | 0.33 | | |
| 2004 | 137 | 0.91 | 0 | 0 | 654 | 0.36 | | |
| 2005 | 470 | 0.51 | 7.2 | 0.48 | 630 | 0.23 | | |
| 2006 | 511 | 0.32 | 6.5 | 0.49 | 514 | 0.31 | | |
| 2007 | 58 | 1.03 | 5.6 | 0.46 | 395 | 0.37 | | |
| 2008 | 350 | 0.75 | 5.6 | 0.97 | 666 | 0.48 | | |
| 2009 | 201 | 0.55 | 0 | 0 | 591 | 0.23 | | |
| 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 | | |
| 2013 | 19 | 1.06 | 7 | 0.98 | 399 | 0.33 | | |
| 2014 | 22 | 1.03 | 5.5 | 0.86 | 128 | 0.27 | | |

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

**Common Bottlenose Dolphin, Atlantic Offshore Stock**

| | Mid-Atlantic Bottom Trawl | | Mid-Atlantic Gillnet | | North Atlantic Bottom Trawl | | NE Sink Gilllnet | | Pelagic Drift Gillnet | | Pelagic Longline | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_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 | .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 | 27 | 0.95 | | | 0 | 0 |
| 2014 | 25 | 0.66 | 0 | 0 | 0 | 0 | 0 | 0 | | | 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

**White-sided Dolphin**

| | Mid-Atlantic Bottom Trawl | | Mid-Atlantic Gillnet | | Mid-Atlantic Midwater Trawl | | North Atlantic Bottom Trawl | | NE Sink Gilllnet | | Northeast Midwater Trawl | | Pelagic Drift Gillnet | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_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 | | |

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

**Risso's Dolphin, Western North Atlantic Stock**

| | Mid-Atlantic Bottom Trawl | | Mid-Atlantic Gillnet | | North Atlantic Bottom Trawl | | NE Sink Gilllnet | | Pelagic Longline | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_est | CV | SI&M_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 | 46 | 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 |

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

**Long-finned Pilot Whale, Western North Atlantic Stock**

| | Mid-Atlantic Bottom Trawl | | Mid-Atlantic Midwater Trawl | | North Atlantic Bottom Trawl | | NE Sink Gilllnet | | Northeast Midwater Trawl | | Pelagic Longline | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_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 | |

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

**Short-finned Pilot Whale, Western North Atlantic Stock**

| | PLL | |
|---|---|---|
| **Year** | **SI&M_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 |

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

**Common Dolphin, Western North Atlantic Stock**

| | Mid-Atlantic Bottom Trawl | | Mid-Atlantic Gillnet | | North Atlantic Bottom Trawl | | NE Sink Gilllnet | | Northeast Midwater Trawl | | Pelagic Drift Gillnet | | Pelagic Longline | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_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 |

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 Gilllnet | | Northeast Midwater Trawl | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_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 |

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 Gilllnet | | Northeast Midwater Trawl | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **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 |

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 Gilllnet | |
|---|---|---|---|---|---|---|
| **Year** | **SI&M_est** | **CV** | **SI&M_est** | **CV** | **SI&M_est** | **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 |

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

# APPENDIX VI: Reports not updated in 2016

| Species | Stock | Updated |
|---|---|---|
| Blue whale | Western North Atlantic | 2010 |
| Sperm whale | North Atlantic | 2014 |
| Killer whale | Western North Atlantic | 2014 |
| Pygmy killer whale | Western North Atlantic | 2007 |
| False killer whale | Western North Atlantic | 2014 |
| Northern bottlenose whale | Western North Atlantic | 2014 |
| Sowerby’s beaked whale | Western North Atlantic | 2014 |
| Cuvier's beaked whale | Western North Atlantic | 2013 |
| Blainville's beaked whale | Western North Atlantic | 2013 |
| Gervais' beaked whale | Western North Atlantic | 2013 |
| True's beaked whale | Western North Atlantic | 2013 |
| Melon-headed whale | Western North Atlantic | 2007 |
| White-beaked dolphin | Western North Atlantic | 2007 |
| Atlantic spotted dolphin | Western North Atlantic | 2013 |
| Pantropical spotted dolphin | Western North Atlantic | 2013 |
| Striped dolphin | Western North Atlantic | 2013 |
| Fraser's dolphin | Western North Atlantic | 2007 |
| Rough-toothed dolphin | Western North Atlantic | 2013 |
| Clymene dolphin | Western North Atlantic | 2013 |
| Spinner dolphin | Western North Atlantic | 2013 |
| Common bottlenose dolphin | Western North Atlantic, northern migratory coastal | 2015 |
| Common bottlenose dolphin | Western North Atlantic, southern migratory coastal | 2015 |
| Common bottlenose dolphin | Western North Atlantic, S. Carolina/Georgia coastal | 2015 |
| Common bottlenose dolphin | Western North Atlantic, northern Florida coastal | 2015 |
| Common bottlenose dolphin | Western North Atlantic, central Florida coastal | 2015 |
| Common bottlenose dolphin | Northern North Carolina Estuarine System | 2015 |
| Common bottlenose dolphin | Southern North Carolina Estuarine System | 2015 |
| Common bottlenose dolphin | Northern South Carolina Estuarine System | 2015 |
| Common bottlenose dolphin | Charleston Estuarine System | 2015 |
| Common bottlenose dolphin | Northern GA/ Southern South Carolina Estuarine System | 2015 |
| Common bottlenose dolphin | Central Georgia Estuarine System | 2015 |
| Common bottlenose dolphin | Southern Georgia Estuarine System | 2015 |
| Common bottlenose dolphin | Jacksonville Estuarine System | 2015 |
| Common bottlenose dolphin | Indian River Lagoon Estuarine System | 2015 |
| Common bottlenose dolphin | Biscayne Bay | 2013 |
| Common bottlenose dolphin | Florida Bay | 2013 |
| Harp seal | Western North Atlantic | 2013 |
| Hooded seal | Western North Atlantic | 2007 |
| Bryde’s whale | Gulf of Mexico | 2015 |
| Cuvier's beaked whale | Gulf of Mexico Oceanic | 2012 |
| Blainville's beaked whale | Gulf of Mexico Oceanic | 2012 |
| Gervais' beaked whale | Gulf of Mexico Oceanic | 2012 |
| Common bottlenose dolphin | Gulf of Mexico Oceanic | 2014 |

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|---|---|---|
| Common bottlenose dolphin | Gulf of Mexico, Continental shelf | 2015 |
| Common bottlenose dolphin | Gulf of Mexico, eastern coastal | 2015 |
| Common bottlenose dolphin | Gulf of Mexico, northern coastal | 2015 |
| Common bottlenose dolphin | Gulf of Mexico, western coastal | 2015 |
| Common bottlenose dolphin | Gulf of Mexico, Oceanic | 2015 |
| Common bottlenose dolphin | Gulf of Mexico, bay, sound and estuary (27 stocks) | 2015 |
| Common bottlenose dolphin | Barataria Bay | 2015 |
| Common bottlenose dolphin | Mississippi Sound, Lake Borgne, Bay Boudreau | 2015 |
| Common bottlenose dolphin | St. Joseph Bay | 2015 |
| Common bottlenose dolphin | Choctawhatchee Bay | 2015 |
| Atlantic spotted dolphin | Gulf of Mexico | 2015 |
| Pantropical spotted dolphin | Gulf of Mexico | 2015 |
| Rough-toothed dolphin | Gulf of Mexico (Outer continental shelf and Oceanic) | 2012 |
| Clymene dolphin | Gulf of Mexico Oceanic | 2012 |
| Fraser's dolphin | Gulf of Mexico Oceanic | 2012 |
| Killer whale | Gulf of Mexico Oceanic | 2012 |
| False killer whale | Gulf of Mexico Oceanic | 2012 |
| Pygmy killer whale | Gulf of Mexico Oceanic | 2012 |
| Dwarf sperm whale | Gulf of Mexico Oceanic | 2012 |
| Pygmy sperm whale | Gulf of Mexico Oceanic | 2012 |
| Melon-headed whale | Gulf of Mexico Oceanic | 2012 |
| Risso's dolphin | Gulf of Mexico | 2015 |
| Pilot whale, short-finned | Gulf of Mexico | 2015 |
| Sperm whale | Gulf of Mexico | 2015 |
| Sperm whale | Puerto Rico and US Virgin Islands stock | 2010 |
| Common bottlenose dolphin | Puerto Rico and US Virgin Islands stock | 2011 |
| Cuvier's beaked whale | Puerto Rico and US Virgin Islands stock | 2011 |
| Pilot whale, short-finned | Puerto Rico and US Virgin Islands stock | 2011 |
| Spinner dolphin | Puerto Rico and US Virgin Islands stock | 2011 |
| Atlantic spotted dolphin | Puerto Rico and US Virgin Islands stock | 2011 |

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# Publications and Reports of the Northeast Fisheries Science Center

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

*NOAA Technical Memorandum NMFS-NE* -- This series is issued irregularly. The series typically includes: data reports of long-term field or lab studies of important species or habitats; synthesis reports for important species or habitats; annual reports of overall assessment or monitoring programs; manuals describing program-wide surveying or experimental techniques; literature surveys of important species or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

*Northeast Fisheries Science Center Reference Document* -- This series is issued irregularly. The series typically includes: data reports on field and lab studies; progress reports on experiments, monitoring, and assessments; background papers for, collected abstracts of, and/or summary reports of scientific meetings; and simple bibliographies. Issues receive internal scientific review and most issues receive copy editing.

*Resource Survey Report* (formerly *Fishermen's Report*) -- This information report is a regularly-issued, quick-turnaround report on the distribution and relative abundance of selected living marine resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. This report undergoes internal review, but receives no technical or copy editing.

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