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Estimates of Cetacean and Pinniped Bycatch in the 2015 New England Sink and Mid-Atlantic Gillnet Fisheries

by Christopher D Orphanides and Joshua M Hatch

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ABSTRACT

This report provides estimated bycatch of 5 species of small cetaceans and pinnipeds bycaught in the New England sink (NESG) and Mid-Atlantic (MAG) gillnet fisheries. The 2015 total serious injuries and mortalities in the NESG fishery were 177 (coefficient of variation [CV] = 0.28) harbor porpoises (*Phocoena phocoena phocoena*), 55 (CV = 0.54) short-beaked common dolphins (*Delphinus delphis delphis*), 1021 (CV = 0.25) gray seals (*Halichoerus grypus grypus*), 474 (CV = 0.17) harbor seals (*Phoca vitulina concolor*), and 119 (CV = 0.34) harp seals (*Pagophilus groenlandicus*). The NESG estimates are based on observed bycatch consisting of 23 harbor porpoises, 3 short-beaked common dolphins, 131 gray seals, 87 harbor seals, and 12 harp seals. The 2015 total serious injuries and mortalities in the MAG fishery were 33 (CV = 1.16) harbor porpoises, 30 (CV = 0.55) short-beaked common dolphins, 15 (CV = 1.04) gray seals, and 48 (CV = 0.52) harbor seals. The MAG estimates are based on observed bycatch consisting of 2 harbor porpoises, 3 short-beaked common dolphins, 1 gray seal, and 5 harbor seals. Compliance with the 2010 Harbor Porpoise Take Reduction Plan pinger regulations was 86% in 2015, where compliance refers to the correct number of pingers used, not the pingers' functionality. Compliance rates in the 2015 MAG fishery were low for large mesh gillnets (55%) and relatively high for small mesh gillnets (87%).

INTRODUCTION

The United States (US) Marine Mammal Protection Act (MMPA) of 1972 mandates the annual reporting of serious injury and mortality estimates for marine mammal stocks interacting with US commercial fisheries (Waring et al. 2016). In the context of this report, an interaction that involves direct contact between a marine mammal and commercial fishing gear and results in a serious injury or mortality is termed a bycatch event. Bycatch has been cited as a significant threat to marine mammal populations (Read 2008), with particular concern for the impacts of drift and sink gillnet gear on small cetacean and pinniped stocks (Reeves et al. 2013). In US Northwest Atlantic waters, fishing vessels that use drift or sink gillnet gear constitute the New England sink (NESG) or Mid-Atlantic (MAG) gillnet fishery. Both fisheries operate year round, with the NESG fishery ranging from Maine to New York and the MAG fishery ranging from New York to North Carolina (NMFS 2014; Waring et al. 2016). Observed fishing hauls are assigned to the NESG or MAG fishery based on the geographic location of fishing activities, with the 72°30'W longitudinal line used to demarcate the 2 fishing fleets (NMFS 2014; Waring et al. 2016).

For 2015, 6 species of small cetaceans and pinnipeds were observed bycaught in drift and sink gillnet gear from US Northwest Atlantic waters, and bycatch was estimated for 5 species. These include harbor porpoise (*Phocoena phocoena phocoena*), short-beaked common dolphin (*Delphinus delphis delphis*), gray seal (*Halichoerus grypus grypus*), harbor seal (*Phoca vitulina concolor*), and harp seal (*Pagophilus groenlandicus*). Two bottlenose dolphins (*Tursiops truncatus truncatus*) were also caught in gillnets in the Mid-Atlantic, but that species is not addressed in this report. The purpose of this report is to: (1) estimate bycatch for small cetaceans and pinnipeds in the 2015 NESG and MAG fisheries and (2) explore gear characteristics of observed hauls in relation to the 2010 Harbor Porpoise Take Reduction Plan (HPTRP).

MATERIALS AND METHODS

Five datasets were used in estimating annual bycatch of small cetaceans and pinnipeds in the NESG and MAG fisheries. These 5 datasets included observer data collected by the Northeast Fisheries Observer Program (NEFOP) and the Northeast Fisheries At-Sea Monitoring Program (ASM) as well as commercial fishing effort from vessel trip reports (VTRs), dealer weigh out slips, and the North Carolina Division of Marine Fisheries (NCDMF) trip ticket program. Observer records from NEFOP and ASM were used to estimate bycatch rates, defined as the number of animals bycaught per metric ton (mt) of landed catch. Estimated bycatch from the entire gillnet fleet was then obtained by applying estimated bycatch rates to commercial fishing effort, defined as the weight of commercial landings in mt.

Data

Observer data

Observer data were recorded by 2 survey programs, NEFOP and ASM. For 2015, 74% and 26% of all hauls observed were from NEFOP and ASM, respectively. In New England, 55% of all hauls were from NEFOP, whereas nearly 100% were from NEFOP in the Mid-Atlantic. Both survey programs used complete sampling protocols (or complete trips), for which observers sampled both catch and discard of fishes for biological information. During complete sampling,

observers were not explicitly watching haulbacks and may have missed bycatch of marine mammals that fell out of the net prior to being hauled on board. Unlike ASM, NEFOP also used limited sampling protocols (or limited trips) for which the observer explicitly watched the net during haulbacks, reducing the chances of unnoticed bycatch. It should also be noted that both survey programs collected environmental, gear, haul, and vessel characteristics during observed fishing trips. However, ASM only collected a subset of the data required by NEFOP and only monitored fishing trips that were declared into the Northeast multispecies groundfish fishery. For this reason, ASM data may not be representative of all gillnet fishing effort with the potential for marine mammal bycatch. Any potential bias introduced into the analysis through the use of ASM data was addressed as described in the bycatch estimates section below.

For the purposes of estimating serious injuries and mortalities of small cetaceans and pinnipeds, bycatch was considered to be any specimen whose condition was recorded as dead (fresh or under varying stages of decomposition) or alive with serious injury. Final serious injury and mortality determinations for specimens observed in the 2015 NESG and MAG fisheries are available in Josephson (2017). Based on these determinations, 1 harbor porpoise was included in the serious injury and mortality estimation when the seriousness of injuries could not be determined, and 1 harbor seal with nonserious injuries was not included.

Bycaught specimens having recorded conditions of moderately to severely decomposed were further examined to ensure that observed decomposition stages were plausible given the recorded soak duration (i.e., the amount of time the gear was in the water). One harbor porpoise was removed from the analysis because of severe decomposition on a 14 hour soak. Animals that could not be identified to the species level, including 10 unknown seals, 2 unknown dolphins, and 1 unknown dolphin or porpoise were removed from the analysis.

Commercial fishing effort

For fishing trips from all states except North Carolina, VTR data were augmented with information from dealer weigh out slips, as self-reported landings on VTRs were assumed to be biased low (Wigley et al. 2008; Murray 2009). Where possible, VTR trips were linked directly to dealer weigh out slips. For instances where corresponding dealer weigh out slips could not be located for a VTR, the landings on the VTR were scaled by an adjustment factor derived from stratification of the VTR and dealer weigh out data by state and season. This ensured that unmatched VTR landings in any stratum were equal to the unmatched landings in the dealer weigh out data (Orphanides 2013), which is assumed to be a near census of commercial catch (Wigley et al. 2008). Commercial fishing effort within bays and sounds was removed from this analysis to reflect fishing effort in oceanic waters where cetacean and pinniped bycatch has historically occurred.

Commercial fishing effort for gillnet trips in North Carolina were poorly represented in the VTR and dealer weigh out data, requiring the use of monthly gillnet landings reported by NCDMF (Orphanides 2011). For vessels landing catch in North Carolina, data from the NCDMF trip ticket program were combined with VTRs and dealer's weigh out slips to estimate fishing effort from this state.

Data Preparation

Data preparation is described in detail below and included the conversion of landed to live weights by using standardized conversion factors (Palmer 2010) as well as imputing missing fishing locations, mesh sizes, and soak durations when needed.

Missing data

In 2015, 3% of observer records were missing latitude and longitude coordinates, while about 3% of vessel trip reports were missing detailed information on geographic fishing locations. Similarly, <1% of observer records were missing values of mesh size, and <2% were missing values of soak duration, while <1% of vessel trip reports were missing information on mesh size, and about 1% were missing information on soak duration. Missing values were imputed following the methods outlined in Warden and Orphanides (2008). Following imputation, missing values for vessel trip reports dropped to <2% for fishing locations, <1% for soak duration, and nearly 0% for mesh size. Missing observer values dropped to about 2% for latitude and longitude and to 0 for soak duration and mesh size.

Bycatch Estimates

As in previous years, bycatch rates were estimated with stratified ratio estimators, with strata defined to reflect the spatial and temporal distributions of marine mammals and commercial gillnetters (Rossman and Merrick 1999; Belden et al. 2006). For the NESG fishery, data were stratified temporally by season and spatially by port group or management area. Seasons were defined as “W” (winter: January - May), “S” (summer: June - August), and “F” (fall: September - December). The stratum-specific bycatch rates were then estimated by using NEFOP and ASM data and were weighted by pinger use and NEFOP-observed groundfish/nongroundfish landings. Only NEFOP-observed groundfish/nongroundfish landings were used to ensure that estimated bycatch rates were representative of the entire NESG fishery and not biased towards the part of the fleet monitored by ASM. In other words,

$$R_{sm} = \left(\frac{W_{s,m,g}}{W_{s,m}} \right) \left[\left(\frac{N_{s,m,g,p}}{N_{s,m,g,p}} \right) \frac{y_{s,m,g,p}}{x_{s,m,g,p}} + \left(\frac{N_{s,m,g,np}}{N_{s,m,g}} \right) \frac{y_{s,m,g,np}}{x_{s,m,g,np}} \right] + \left(\frac{W_{s,m,ng}}{W_{s,m}} \right) \left[\left(\frac{N_{s,m,ng,p}}{N_{s,m,ng,p}} \right) \frac{y_{s,m,ng,p}}{x_{s,m,ng,p}} + \left(\frac{N_{s,m,ng,np}}{N_{s,m,ng}} \right) \frac{y_{s,m,ng,np}}{x_{s,m,ng,np}} \right] \quad (1)$$

where:

$$N_{s,m,g} = N_{s,m,g,p} + N_{s,m,g,np}$$

$$N_{s,m,ng} = N_{s,m,ng,p} + N_{s,m,ng,np}$$

$$W_{s,m} = W_{s,m,g} + W_{s,m,ng}$$

s = season

m = port group or management area

g = groundfish and ng = nongroundfish

p = pingers and np = no pingers

\hat{R} = stratum-specific bycatch rate

W = NEFOP-observed weight of landed catch (mt)

N = observed number of hauls

y = observed number of bycaught animals
 x = observed weight of landed catch (mt)

The weighted bycatch rate explicitly accounts for observed fishing effort targeting groundfish versus nongroundfish and the use of pingers on gillnet strings (Palka et al. 2008; Orphanides 2013).

The East of Cape Cod port group was not retained for the purposes of estimating bycatch during the 2015 winter season to address concerns with small sample size (4 hauls) and was pooled with the Southern New England Management Area. The Cape Cod South Closure Area was retained for the purposes of estimating bycatch during 2015 to address concerns with inshore/offshore differences in fishing practices. The time period used for the Cape Cod South Closure Area extended from December through May to match that of the Southern New England Management Area, while the actual closure only includes the month of March.

For the MAG fishery, data in the Waters off New Jersey Management Area were stratified temporally by season as well as by mesh size (i.e., < 7 in or ≥ 7 in) and soak duration (i.e., ≤ 72 hours or > 72 hours) (Orphanides 2013). More formally this can be expressed as:

$$\hat{R} = \frac{y}{x} \tag{2}$$

where:

\hat{R} = stratum-specific bycatch rate
 y = observed, stratum-specific number of bycaught animals
 x = observed, stratum-specific weight of landed catch (mt)

For a more in-depth treatment of the rationale behind the data stratification presented in this report, refer to Orphanides (2011, 2013).

Estimates of bycatch in any stratum (\hat{B}) were then obtained through the product of stratum-specific bycatch rates (\hat{R}) and the total commercial fishing effort (E) associated with that stratum. More formally this can be expressed as:

$$\hat{B} = \hat{R}E \tag{3}$$

Seasonal subtotal and total bycatch estimates were obtained through the summation of stratum-specific bycatch estimates. Uncertainty around seasonal subtotal, total, and stratum-specific bycatch estimates were calculated by using nonparametric stratified bootstrapping techniques, with $(1 - \alpha)\%$ confidence intervals constructed through the bias-corrected and accelerated (BCa) method using 10,000 iterations with the R “boot” library (Canty and Ripley 2012; Efron and Tibshirani 1993). The resampling unit used for bootstrapping was an entire fishing trip, to account for interdependence among hauls nested within trips (Bisack 2003).

For strata with high observer coverage (i.e., $\geq 10\%$) the finite population correction factor (fpc) was applied to the bootstrapped estimate of the standard error used in calculating the coefficient of variation (CV), where the fpc for each stratum was defined as:

$$fpc = \sqrt{\frac{W-w}{W-1}} \quad (4)$$

where:

W = stratum-specific weight of commercial landings

w = observed, stratum-specific weight of landed catch

Observer coverage was defined as the percentage of commercial landings observed by NEFOP and ASM for each stratum (i.e., $w/W \times 100\%$).

RESULTS

Observed hauls were concentrated in the Gulf of Maine; southern New England; and off New Jersey, Delaware, Maryland, and North Carolina (Figure 1). Marine mammal bycatch was observed in waters off New Jersey and farther north, with the majority of bycatch being observed incoastal Gulf of Maine waters, as well as off Cape Cod, MA, and southern New England (Figure 1).

New England Sink Gillnet fishery

The annual observer coverage for the 2015 NESG fishery was 14% (Table 1). Stratum-specific observer coverage rates for the NESG fishery can be found in Table 1 and ranged between 0% in the Massachusetts Bay Management Area during the fall and 100% in the south of Boston port group during the winter. The 2015 serious injuries and mortalities in the NESG fishery were 177 (CV = 0.28) harbor porpoises (Table 2), 55 (CV = 0.54) short-beaked common dolphins (Table 3), 1021 (CV = 0.25) gray seals (Table 4), 474 (CV = 0.17) harbor seals (Table 5), and 119 (CV = 0.34) harp seals (Table 6). The NESG estimates are based on observed bycatch consisting of 23 harbor porpoises, 3 short-beaked common dolphins, 131 gray seals, 87 harbor seals, and 12 harp seals.

Compliance of observed hauls to management regulations stipulated in the 2010 HPTRP was measured in terms of full pinger deployment (i.e., correct number of pingers on a gillnet string). For 2015, full pinger deployment ranged from 74-100% (Table 7). The lowest proportion of observed hauls with the correct number of pingers occurred during the fall season within the Southern New England Management Area and in the Cape Cod South Management Area during the winter (Figure 1) where 74% and 76% of observed hauls were compliant with the 2010 HPTRP, respectively (Table 7). No hauls were observed in New England HPTRP closed areas.

Mid-Atlantic Gillnet Fishery

The annual observer coverage for the 2015 MAG fishery was 6.3% (Table 8). Stratum-specific observer coverage rates for the MAG fishery ranged between 6.0% and 11.5% (Table 9). The 2015 serious injuries and mortalities in the MAG fishery were 33 (CV = 1.16) harbor porpoises, 30 (CV = 0.55) short-beaked common dolphins, 48 (CV = 0.52) harbor seals, and 15 (CV = 1.04) gray seals (Table 10). The MAG estimates are based on observed bycatch consisting of 2 harbor porpoises, 3 short-beaked common dolphins, 5 harbor seals, and 1 gray seal.

Compliance of observed hauls to management regulations stipulated in the 2010 HPTRP ranged between 33 - 86% for large-mesh gillnets and 87 - 100% for small-mesh gillnets (Table

11). Two observed hauls using large-mesh gillnets were found to be fishing in the Mudhole South Management Area during the time-area closure (Table 11) but had no marine mammal bycatch.

DISCUSSION

The majority of small cetacean and pinniped bycatch occurring in US waters is from gillnet gear (Read et al. 2006), with the most frequently bycaught species in 2015 being gray seals, followed by harbor seals, harbor porpoises, short-beaked common dolphins, and harp seals. The total 2015 gray seal bycatch estimate (1036) was similar to the 2014 estimate (939) (Hatch and Orphanides, 2016) and the 2009-2013 5-year mean (1136) (Waring et al. 2016). The 2015 harbor seal bycatch estimate (564) was slightly higher than recent annual estimates (2014 = 449; 2009-2013 5-year mean = 389), but well within recent 95% confidence intervals (Hatch and Orphanides 2016; Waring et al. 2016).

Total regional harbor porpoise bycatch in 2015 (210) was among the lowest ever estimated in these waters and very similar to the 2014 estimate (150). Overall New England compliance to 2010 HPTRP regulations was 86%, which is very similar to 2014 (87%) (Hatch and Orphanides, 2016). This compliance refers to the correct number of pingers on a gillnet string and not functionality. These compliance rates are quite high relative to historical pinger compliance rates of 43% reported for the 2009-2010 fishing season (Orphanides 2012) and roughly 0 - 40% in 2004 (Palka et al. 2008). In contrast, compliance rates in the 2015 MAG fishery were low for large mesh gillnets (55%) but relatively high for small mesh gillnets (87%). The most prevalent observed violations in the large mesh fishery were 19 twine size violations in the Waters off New Jersey. The most often observed small mesh violations also involved twine size restrictions. The 2015 Mid-Atlantic compliance rates are typical compared with recent years (e.g., Orphanides 2012).

Assessing the status of marine mammal stocks is fraught with uncertainty (Williams et al. 2008), which is usually compounded by inadequate funds to achieve necessary observer coverage of relevant fisheries with historical bycatch. Relatively imprecise estimates make it difficult to detect trends in bycatch over time (i.e., increasing, decreasing, or stable), a situation that is complicated by the rarity with which marine mammals and gillnets interact. Since increased observer coverage in the NESG or MAG fishery is unlikely, other estimators or stratification schemes could be explored to improve the precision of marine mammal bycatch estimates for future years.

REFERENCES CITED

- Belden DL, Orphanides CD, Rossman MC, Palka DL. 2006. Estimates of cetacean and seal bycatch in the 2004 Northeast sink gillnet and mid-Atlantic coastal gillnet fisheries. US Dep Commer, Northeast Fish Sci Cent Ref Doc 06-13; 24 p. Available at: <http://www.nefsc.noaa.gov/publications/>
- Bisack KD. 2003. Estimates of marine mammal bycatch in the Northeast (New England) multispecies sink gillnet fishery in 1996. US Dep Commer, Northeast Fish Sci Cent Ref Doc 03-18; 18 p. Available at: <http://www.nefsc.noaa.gov/publications/>
- Canty A, Ripley B. 2012. Boot: Bootstrap R (S-Plus) Functions. R package version 1.3-7.
- Efron B, Tibshirani RJ. 1993. An introduction to the bootstrap. New York [NY]. Chapman and Hall. 436 p.
- Hatch J, Orphanides C. 2016. Estimates of cetacean and pinniped bycatch in the 2014 New England sink and mid-Atlantic gillnet fisheries. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 16-05; 22 p. Available at: <http://www.nefsc.noaa.gov/publications/>
- Josephson E, Wenzel F, Lyssikatos, MC. 2017 Serious injury determinations for small cetaceans and pinnipeds caught in commercial fisheries off the northeast U.S. coast, 2011-2015. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 17-15; 32 p.
- Murray KT. 2009. Characteristics and magnitude of sea turtle bycatch in U.S. Mid-Atlantic gillnet gear. Endang Species Res. 8:211–224.
- NMFS. 2014. List of Fisheries for 2015. Federal Register, Vol. 79, No. 248, Monday, December 29, 2014. p. 77919-77942. Available at: <http://www.gpoaccess.gov/fr/retrieve.html>
- Orphanides CD. 2011. Estimates of cetacean and pinniped bycatch in the 2009 New England sink gillnet and mid-Atlantic gillnet fisheries. US Dept Commer, Northeast Fish Sci Cent Ref Doc 11-08; 28 p. Available at: <http://www.nefsc.noaa.gov/publications/>
- Orphanides CD. 2012. Update on harbor porpoise take reduction plan monitoring initiatives: compliance and consequential bycatch rates from June 2009 through May 2010. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-22; 21 p. Available at: <http://www.nefsc.noaa.gov/publications/>
- Orphanides CD. 2013. Estimates of cetacean and pinniped bycatch during 2010 and 2011 in the New England sink gillnet fishery, mid-Atlantic gillnet fishery, and two NMFS gillnet experiments, 2nd edition. US Dept Commer, Northeast Fish Sci Cent Ref Doc 13-13; 37 p. Available at: <http://nefsc.noaa.gov/publications/>
- Palka DL, Rossman MC, VanAtten AS, Orphanides CD. 2008. Effect of pingers on harbour porpoise (*Phocoena phocoena phocoena*) bycatch in the US Northeast gillnet fishery. J

- Cetacean Res Manage. 10(3): 217-226.
- Palmer MC. 2010. A standard method to apportion groundfish catch to stock area for the purpose of real time quota monitoring under Amendment 16. US Dept Commer, Northeast Fish Sci Cent Ref Doc 10-02; 32 p. Available at: <http://nefsc.noaa.gov/publications/>
- Read AJ. 2008. The looming crisis: interactions between marine mammals and fisheries. *J Mammal.* 89(3):541–548.
- Read AJ, Drinker P, Northridge S. 2006. Bycatch of marine mammals in U.S. and global fisheries. *Conserv Biol.* 20(1):163-169.
- Reeves RR, McClellan K, Werner TB. 2013. Marine mammal bycatch in gillnet and other entangling net fisheries, 1990 to 2011. *Endang Species Res.* 20:71-97.
- Rossmann MC, Merrick RL. 1999. Harbor porpoise bycatch in the Northeast multispecies sink gillnet fishery and the Mid-Atlantic coastal gillnet fishery in 1998 and during January - May 1999. US Dep Commer, Northeast Fish Sci Cent Ref Doc 99-17; 36 p. Available at: <http://nefsc.noaa.gov/publications/>
- Warden ML, Orphanides CD. 2008. Preparation of the Northeast Fisheries Observer Program gillnet data for use in bycatch analyses of protected species. US Dept Commer, Northeast Fish Sci Cent Ref Doc 08-17; 44 p. Available at: <http://nefsc.noaa.gov/publications/>
- Waring GT, Josephson E, Maze-Foley K, Rosel, PE, editors. 2016. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2015. NOAA Tech Memo NMFS NE 238; 501 p. Available at: <http://www.nefsc.noaa.gov/nefsc/publications/>
- Wigley SE, Hersey P, Palmer JE. 2008. A description of the allocation procedure applied to the 1994 to 2007 commercial landings data. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 08-18; 61 p. Available at: <http://www.nefsc.noaa.gov/publications/>
- Williams R, Hall A, Winship A. 2008. Potential limits to anthropogenic mortality of small cetaceans in coastal waters of British Columbia. *Can J Fish Aquat Sci.* 65:1867-1878.

Table 1. Summaries of observed hauls, observed trips, observed landings, prorated commercial landings, and observer coverage by season and port group (P)/management area (MA) for the 2015 New England sink gillnet fishery. Seasons were defined as "W" (winter; January - May), "S" (summer; June - August), and "F" (fall; September - December).

Season	Port Group (P)/ Management Area (MA)	Observed Hauls ^a	Observed Trips	Observed Landings (mt)	Commercial Landings (mt)	Observer Coverage
W	Cape Cod South (MA)	114 (53)	31	62.17	773.37	0.08
W	Massachusetts Bay (MA)	4 (0)	1	0.45	1.74	0.26
W	Mid-Coast (MA)	52 (13)	12	4.11	22.81	0.18
W	North of Boston (P)	16 (0)	1	1.30	32.37	0.04
W	Offshore (MA)	217 (0)	20	49.23	227.74	0.22
W	Offshore (P)	55 (0)	6	20.52	70.19	0.29
W	South of Boston (P)	5 (0)	2	0.95	0.95	1.00
W	South of Cape Cod (P)	27 (12)	10	3.39	143.64	0.02
W	Southern Maine (P)	40 (0)	4	7.64	45.86	0.17
W	Southern New England (MA)	322 (141)	71	257.89	2654.62	0.10
W	Stellwagen Bank (MA)	50 (7)	15	7.70	42.32	0.18
W	Subtotal	902 (226)	173	415.35	4014.66	0.10
S	East of Cape Cod (P)	420 (0)	177	598.40	3014.99	0.20
S	New Hampshire (P)	124 (0)	42	73.65	462.30	0.16
S	North of Boston (P)	145 (0)	33	56.20	340.51	0.17
S	Offshore (P)	221 (0)	17	56.26	299.89	0.19
S	South of Boston (P)	136 (0)	28	25.70	94.03	0.27
S	South of Cape Cod (P)	217 (7)	46	99.03	1891.02	0.05
S	Southern Maine (P)	132 (0)	28	40.15	67.97	0.59
S	Subtotal	1395 (7)	371	949.39	6170.71	0.15
F	Cape Cod South (MA)	107 (79)	20	54.56	324.19	0.17
F	East of Cape Cod (P)	314 (107)	103	237.29	1132.28	0.21
F	Massachusetts Bay (MA)	0 (0)	0	0	3.64	0.00
F	Mid-Coast (MA)	366 (68)	94	108.20	426.56	0.25
F	New Hampshire (P)	28 (9)	7	9.46	52.84	0.18
F	North of Boston (P)	87 (41)	29	29.45	71.28	0.41
F	Offshore (MA)	39 (0)	4	19.00	129.88	0.15
F	Offshore (P)	199 (19)	18	63.40	282.26	0.22
F	South of Boston (P)	47 (14)	9	11.83	62.46	0.19
F	South of Cape Cod (P)	174 (96)	37	69.66	1064.00	0.07
F	Southern Maine (P)	44 (4)	11	13.43	43.09	0.31
F	Southern New England (MA)	19 (4)	4	7.70	286.58	0.03
F	Stellwagen Bank (MA)	93 (24)	33	25.15	66.24	0.38
F	Subtotal	1517 (465)	369	649.13	3945.30	0.16
Total		3814 (698)	913	2013.87	14131.62	0.14

^a Parentheses indicate the number of limited hauls out of the total (i.e., complete + limited).

Table 2. Observed number of bycatch, estimated bycatch rates, estimated bycatch, coefficient of variation (CV), and lower (L) and upper (U) limits on 95% confidence intervals (CI) of harbor porpoise (*Phocoena phocoena phocoena*) bycatch in the New England sink gillnet fishery for 2015, by season and port group (P)/management area (MA). Seasons were defined as "W" (winter: January - May), "S" (summer: June - August), and "F" (fall: September - December).

Port Group (P)/ Season	Management Area (MA)	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Mid-Coast (MA)	1	0.244	5.57	1.27	1	43
W	Cape Cod South (MA)	2	0.034	26.29	0.76	2	95
W	Southern New England (MA)	10	0.039	103.53	0.45	37	236
W	Subtotal	13	-	135.39	0.36	61	272
S	North of Boston (P)	1	0.018	6.13	0.93	1	33
S	Subtotal	1	-	6.13	0.93	1	33
F	Mid-Coast (MA)	9	0.084	35.83	0.43	12	91
F	Subtotal	9	-	35.83	0.45	12	91
Total		23	-	177.35	0.28	94	314

Table 3. Observed number of bycatch, estimated bycatch rates, estimated bycatch, coefficient of variation (CV), and lower (L) and upper (U) limits on 95% confidence intervals (CI) of short-beaked common dolphin (*Delphinus delphis delphis*) bycatch in the New England sink gillnet fishery for 2015, by season and port group (P)/management area (MA). Seasons were defined as "W" (winter: January - May), "S" (summer: June - August), and "F" (fall: September- December).

Port Group (P)/ Season	Management Area (MA)	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Southern New England (MA)	2	0.012	31.86	0.65	2	104
W	Subtotal	2	-	31.86	0.62	2	104
S	South of Cape Cod (P)	1	0.012	22.69	1.06	1	139
S	Subtotal	1	-	22.69	0.98	1	139
	Total	3	-	54.55	0.54	13	170

Table 4. Observed number of bycatch, estimated bycatch rates, estimated bycatch, coefficient of variation (CV), and lower (L) and upper (U) limits on 95% confidence intervals (CI) of gray seal (*Halichoerus grypus grypus*) bycatch in the New England sink gillnet fishery for 2015, by season and port group (P)/management area (MA). Seasons were defined as "W" (winter: January - May), "S" (summer: June - August), and "F" (fall: September - December).

Season	Port Group (P)/ Management Area (MA)	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Cape Cod South (MA)	7	0.112	86.62	0.47	31	208
W	Southern New England (MA)	65	0.235	623.84	0.41	295	1544
W	Stellwagen Bank	1	0.130	5.50	0.93	1	27
W	Subtotal	73	-	715.96	0.34	383	1610
S	East of Cape Cod (P)	22	0.037	111.55	0.48	39	360
S	North of Boston (P)	4	0.071	24.18	0.50	6	64
S	New Hampshire (P)	1	0.012	5.55	0.95	1	24
S	Southern Maine (P)	1	0.025	1.70	0.67	1	10
S	South of Cape Cod (P)	1	0.012	22.69	0.98	1	117
S	Subtotal	29	-	165.67	0.36	84	422
F	East of Cape Cod (P)	11	0.047	53.22	0.31	25	103
F	Mid-Coast (MA)	13	0.121	51.61	0.32	24	106
F	North of Boston (P)	1	0.028	2.00	0.90	1	14
F	South of Cape Cod (P)	2	0.026	27.66	2.05	2	287
F	Cape Cod South (MA)	2	0.016	5.19	1.35	2	40
F	Subtotal	29	-	139.68	0.41	74	322
Total		131	-	1021.31	0.25	644	1852

Table 5. Observed number of bycatch, estimated bycatch rates, estimated bycatch, coefficient of variation (CV), and lower (L) and upper (U) limits on 95% confidence intervals (CI) of harbor seal (*Phoca vitulina concolor*) bycatch in the New England sink gillnet fishery for 2015, by season and port group (P)/management area (MA). Seasons were defined as "W" (winter: January - May), "S" (summer: June - August), and "F" (fall: September - December).

Season	Port Group (P)/ Management Area (MA)	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Cape Cod South (MA)	1	0.009	6.96	1.06	1	34
W	Southern New England (MA)	5	0.019	50.44	0.43	19	109
W	Subtotal	6	-	57.40	0.37	23	119
S	North of Boston (P)	11	0.194	66.06	0.39	24	143
S	New Hampshire (P)	13	0.244	112.80	0.39	44	250
S	Offshore (P)	1	0.018	5.40	0.97	1	31
S	Southern Maine (P)	2	0.050	3.40	0.68	2	21
S	South of Cape Cod (P)	1	0.008	15.13	0.96	1	62
S	Subtotal	28	-	202.79	0.26	114	354
F	East of Cape Cod (P)	1	0.004	4.53	0.96	1	16
F	Mid-Coast (MA)	46	0.427	182.14	0.28	95	340
F	North of Boston (P)	3	0.084	5.99	0.61	3	24
F	Southern Maine (P)	1	0.063	2.71	1.07	1	19
F	Cape Cod South (MA)	2	0.057	18.48	0.65	2	60
F	Subtotal	53	-	213.85	0.26	122	373
Total		87	-	474.04	0.17	330	678

Table 6. Observed number of bycatch, estimated bycatch rates, estimated bycatch, coefficient of variation (CV), and lower (L) and upper (U) limits on 95% confidence intervals (CI) of harp seal (*Pagophilus groenlandicus*) bycatch in the New England sink gillnet fishery for 2015, by season and port group (P)/management area (MA). "W" indicates the season (winter; January - May).

Port Group (P)/ Season	Management Area (MA)	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Cape Cod South (MA)	2	0.034	26.29	0.79	2	101
W	Southern New England (MA)	10	0.035	92.91	0.42	35	191
W	Subtotal	12	-	119.20	0.35	51	233
Total		12	-	119.20	0.34	51	233

Table 7. Summary of 2015 full pinger deployment for Northeast Fisheries Observer Program observed hauls within times and areas where pingers were required by the 2010 Harbor Porpoise Take Reduction Plan (HPTRP). Seasons were defined as "Winter" (January - May) and "Fall" (September - December).

Season	Management Area	General Compliance			Specific Compliance		
		Observed Hauls	Pinger Violations	Compliance Rate	No Pingers	<90% Required Pingers	90-99% Required Pingers
Fall	Cape Cod South ^a	107	0	100%	0	0	0
	Mid-Coast	366	50	86%	42	7	1
	Offshore	39	7	82%	7	0	0
	Southern New England	19	5	74%	5	0	0
	Stellwagen Bank	93	13	86%	11	0	2
Winter	Cape Cod South ^a	114	27	76%	23	4	0
	MassBay	4	0	100%	0	0	0
	MidCoast	52	0	100%	0	0	0
	Offshore	217	48	78%	0	0	48
	Southern New England	322	45	86%	28	12	5
	Stellwagen Bank	50	1	98%	0	1	0
Totals		1383	196	86%	116	24	56

^a Cape Cod South specification includes Dec-May, matching that used for the bycatch estimation strata

Table 8. Summaries of observed landings, prorated commercial landings, and observer coverage by state for the 2015 Mid-Atlantic gillnet fishery (Figure 1b). Effort from bays and sounds are not included.

State	Observed Landings (mt)	Commercial Landings (mt)	Observer Coverage
Maryland	40.15	745.09	5.39%
North Carolina	182.59	4011.90	4.55%
New Jersey	287.03	2806.82	10.23%
New York	16.09	232.61	6.92%
Virginia	77.62	1706.73	4.55%
Massachusetts	0.00	3.38	0.00%
Rhode Island	0.00	47.57	0.00%
Delaware	0.00	9.77	0.00%
Totals	603.49	9563.87	6.31%

Table 9. Summaries of observed hauls, observed trips, observed landings, prorated commercial landings, and observer coverage by species, season, region, mesh size, and soak duration for strata with bycatch of harbor porpoise (*Phocoena phocoena phocoena*), gray seal (*Halichoerus grypus grypus*), short-beaked common dolphin (*Delphinus delphis delphis*), or harbor seal (*Phoca vitulina concolor*) in the 2015 Mid-Atlantic gillnet fishery.

Species	Season	Region	Mesh Size (in)	Soak Duration (hrs)	Observed Hauls ^a	Observed Trips	Observed Landings (mt)	Commercial Landings (mt)	Observer Coverage
Harbor Porpoise	Jan-Apr	Waters off NJ	>=7	>72	41 (4)	10	15.46	259.60	5.96%
Gray Seal	May	Waters off NJ	>=7	>72	41 (10)	12	21.12	310.34	6.81%
Common Dolphin	Dec-Jan	Waters off NJ	>=7	>72	65 (4)	14	29.91	260.97	11.46%
Common Dolphin	Dec-Jan	Waters off NJ	>=7	<=72	87 (17)	21	30.32	329.49	9.20%
Harbor Seal	Dec-Mar	Waters off NJ	>=7	>72	79 (4)	17	33.81	319.46	10.58%
Harbor Seal	Dec-Mar	Waters off NJ	>=7	<=72	99 (17)	25	33.46	344.77	9.71%

^a Parentheses indicate number of limited hauls out of the total

Table 10. Observed number of bycatch, estimated bycatch rates, estimated bycatch, coefficient of variation (CV), and lower and upper limits on 95% confidence intervals (CI) of estimated harbor porpoise (*Phocoena phocoena phocoena*), gray seal (*Halichoerus grypus grypus*), short-beaked common dolphin (*Delphinus delphis delphis*), and harbor seal (*Phoca vitulina concolor*) bycatch in the Mid-Atlantic gillnet fishery for 2015, by season, region, mesh size, and soak duration.

Species	Season	Region	Mesh Size (in)	Soak Duration (hrs)	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI
Harbor Porpoise	Jan-Apr	Waters off NJ	>=7	>72	2	0.129	33.49	1.16	2-204
Gray Seal	May	Waters off NJ	>=7	>72	1	0.047	14.59	1.04	1-78
Common Dolphin	Dec-Jan	Waters off NJ	>=7	>72	1	0.033	8.61	0.78	1-33
Common Dolphin	Dec-Jan	Waters off NJ	>=7	<=72	2	0.066	21.75	0.73	2-78
Common Dolphin	Dec-Jan	Waters off NJ	all	all	3		30.36	0.55	8-86
Harbor Seal	Dec-Mar	Waters off NJ	>=7	>72	4	0.118	37.70	0.61	8-119
Harbor Seal	Dec-Mar	Waters off NJ	>=7	<=72	1	0.03	10.34	0.93	1-49
Harbor Seal	Dec-Jan	Waters off NJ	all	all	5		48.04	0.52	11-129

Table 11. Observed number of hauls for large (7-18") and small mesh (<7") gillnets following requirements for the Mid-Atlantic 2010 Harbor Porpoise Take Reduction Plan (HPTRP). Observed hauls missing information for an assessed gear modification were assumed to be following the HPTRP for that gear characteristic. Locations are depicted in Figure 1b.

Management Area	Total Observed Hauls	Non-Compliant Hauls	Compliance %	General Violation Types		Specific Violation Types						
				Gear Modification	Closed Area	Multiple Violations per Haul	Number of Nets	Twine Size	Tie-Down Lengths	Tie-Down Use	Net Length	Unkown Gear Compliance ^a
Southern Mid-Atlantic Large Mesh	14	2	86%	2	0	0	0	0	0	2	0	0
Southern Mid-Atlantic Small Mesh	149	20	87%	20	0	7	1	19	0	0	7	9
Mudhole North Large Mesh	6	4	33%	4	0	0	4	0	0	0	0	0
Mudhole North Small Mesh	11	0	100%	0	0	0	0	0	0	0	0	0
Mudhole South Large Mesh	15	7	53%	5	2	1	5	1	0	0	0	5
Waters off New Jersey Large Mesh	60	30	50%	30	0	0	19	11	0	0	0	17
Waters off New Jersey Small Mesh	5	0	100%	0	0	0	0	0	0	0	0	0

^a At least one gear component was not recorded and therefore could not be checked for compliance

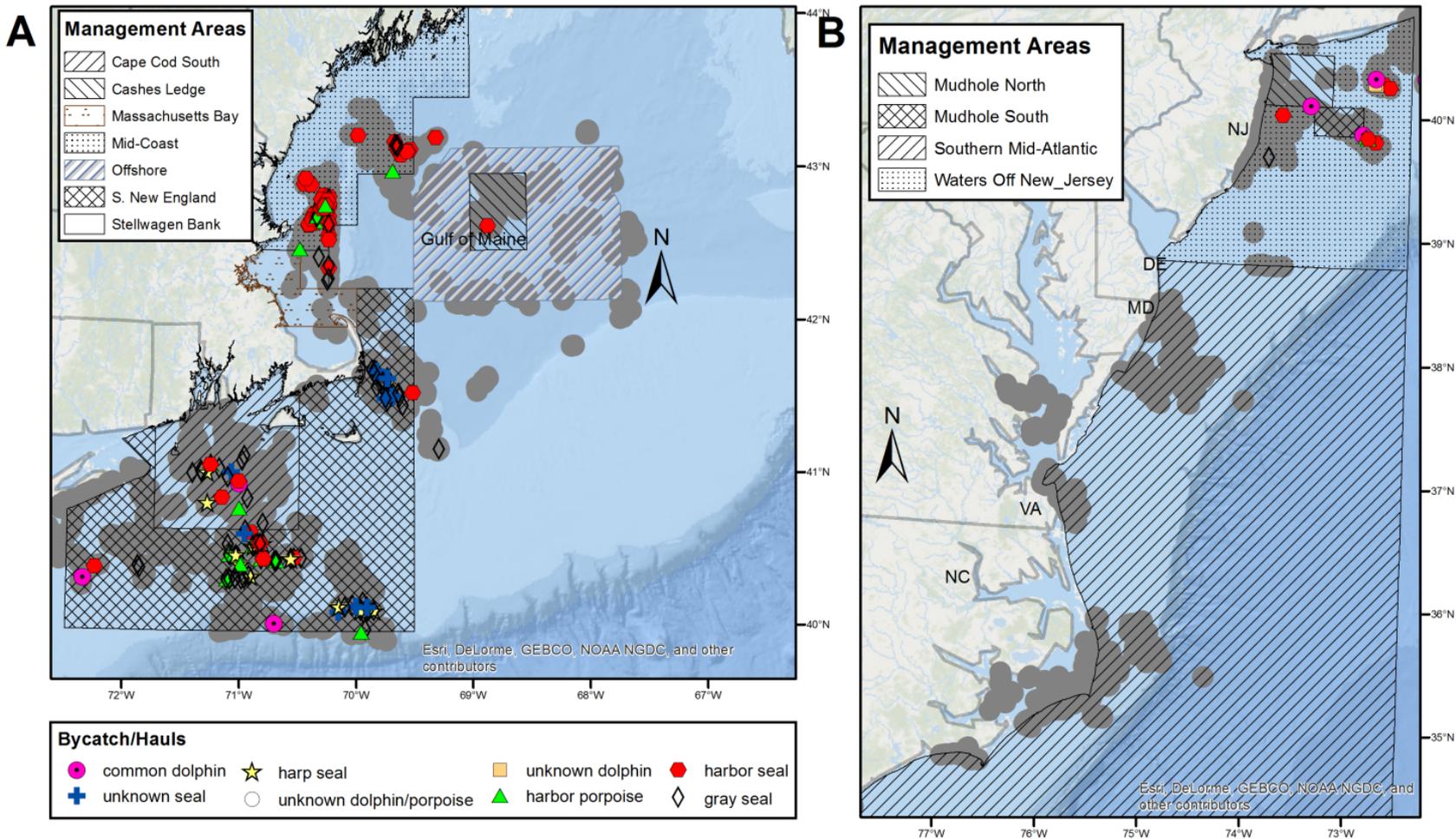


Figure 1. Locations of observed hauls and marine mammal bycatch in the 2015 New England sink (A) and mid-Atlantic (B) gillnet fisheries. Observed bycatch consisted of harbor porpoise (*Phocoena phocoena phocoena*), short-beaked common dolphin (*Delphinus delphis delphis*), gray seal (*Halichoerus grypus grypus*), harbor seal (*Phoca vitulina concolor*), harp seal (*Pagophilus groenlandicus*), and unknown species of seal, dolphin, and dolphin or porpoise.

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