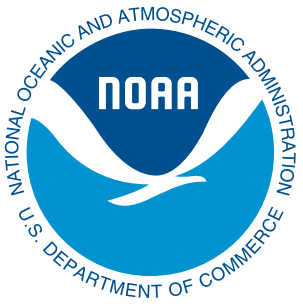

Northeast Fisheries Science Center Reference Document 14-02

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ABSTRACT

This report provides estimated takes of 6 species of small cetaceans and pinnipeds bycaught in the New England sink (NESG) and mid-Atlantic (MAG) gillnet fisheries. The 2012 serious injuries and total mortalities in the NESG fishery were 277 (CV = 0.59) North Atlantic harbor porpoises (*Phocoena phocoena phocoena*), 95 (CV = 0.40) short-beaked common dolphins (*Delphinus delphis delphis*), 9 (CV = 0.92) Atlantic white-sided dolphins (*Lagenorhynchus acutus*), 542 (CV = 0.19) gray seals (*Halichoerus grypus grypus*), 252 (CV = 0.26) harbor seals (*Phoca vitulina concolor*), and 6 (CV = 0.87) Risso's dolphins (*Grampus griseus*). NESG estimates are based on observed takes consisting of 34 harbor porpoises, 6 short-beaked common dolphins, 1 Atlantic white-sided dolphin, 91 gray seals, 37 harbor seals, and 1 Risso's dolphin. The 2012 serious injuries and total mortalities in the MAG fishery were 63 (CV = 0.83) harbor porpoises, 15 (CV = 0.93) short-beaked common dolphins, and 14 (CV = 0.98) gray seals. MAG estimates are based on observed takes consisting of 2 harbor porpoises, 1 short-beaked common dolphin, and 1 gray seal. Relative to 2011, total annual bycatch of all marine mammal species, save short-beaked common dolphin, has declined. However, high uncertainty around estimated takes confounds definitive trends in marine mammal bycatch within the NESG and MAG fisheries.

INTRODUCTION

The United States (US) Marine Mammal Protection Act (MMPA) requires that marine mammal stocks in US waters not fall below their optimum sustainable size. As such, the effects of entanglement in commercial fishing gear on relative abundance need to be assessed with respect to a threshold, beyond which takes or removals from the stock are deemed unsustainable. The MMPA defines this threshold as the Potential Biological Removal (PBR), which is a function of the population size, population growth rate, and a factor that ensures sufficient recovery (Wade 1998). Assessing the implications for fishery-induced mortalities or serious injuries on marine mammal populations requires comparison of annual bycatch estimates to PBR. In particular, there is increasing concern for the impacts of drift and sink gillnet gear on small cetacean and pinniped stocks (Reeves et al. 2013). In the US Northwest Atlantic, focus has been primarily on the bycatch of harbor porpoises in the New England sink (NESG) and mid-Atlantic (MAG) gillnet fisheries and the mitigation strategies imposed to reduce incidental takes (Orphanides and Palka 2013).

The establishment of the Northeast Fishery Observer Program (NEFOP) was, in part, a response to monitor take of marine mammals in commercial fishing operations within the western Atlantic and has been ongoing since 1989 (Orphanides 2013; Waring et al. 2013; Belden 2007). The program was subsequently expanded in 1993 to document fishery interactions with marine mammals in the mid-Atlantic; thus, observer coverage ranged from North Carolina to Maine (Orphanides 2013; Waring et al. 2013; Belden 2007). In 2010 another observer platform (i.e., Northeast Fishery At-Sea Monitoring Program or ASM) was enacted to monitor harvest and discard in the multispecies large-mesh groundfish fishery operating primarily in the Gulf of Maine and southern New England (in waters from Connecticut to Maine), as mandated by Amendment 16 of the Northeast Multispecies Groundfish Fishery Management Plan (15 CFR Part 902, 50 CFR Part 648). While the directive of ASM is to monitor the catch and discard of fishes, unintentional harvest of marine mammals, sea turtles, and seabirds was also recorded, although in not as much detail as documented under NEFOP.

In US Northwest Atlantic waters the NESG and MAG fisheries operate year round, with the NESG fishery ranging from Maine to Connecticut and the MAG fishery ranging from Connecticut to North Carolina (50 CFR Part 229; Waring et al. 2013). Observed gillnetters in both NESG and MAG fisheries utilized nets predominately made of monofilament twine, with string lengths varying from 75 - 10,200 ft and 300 - 7,800 ft, respectively. While the MAG fleet comprises both drift and sink gillnets, the NESG fishery largely comprises anchored and unanchored bottom-tending (i.e., sink) gillnets. Gillnet mesh sizes often vary with target fish species but have been observed to range anywhere from 4.5 - 12 in and 2.5 - 12 in for the NESG and MAG fisheries, respectively.

For 2012, 6 species of small cetaceans and pinnipeds were observed bycaught in drift and sink gillnet gear from US Northwest Atlantic waters. These include North Atlantic harbor porpoise (*Phocoena phocoena phocoena*), short-beaked common dolphin (*Delphinus delphis delphis*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), Risso's dolphin (*Grampus griseus*), gray seal (*Halichoerus grypus grypus*), and harbor seal (*Phoca vitulina concolor*). Total annual bycatch estimates for each species were obtained by applying stratified ratio estimators of bycatch observed in a subset of the fleet to total commercial fishing effort, resulting in estimates of total takes from the entire gillnet fishery.

MATERIALS & METHODS

Data

Four datasets were used in estimating the annual take of small cetaceans and pinnipeds in the NESG and MAG fisheries. These include observer data collected by NEFOP and ASM, as well as total commercial fishing effort from vessel trip reports (VTR) and dealer data. Observer records (NEFOP and ASM) were used to estimate bycatch rates, defined as the number of animals landed per metric ton (mton) of kept catch, for the NESG and MAG fisheries. Total estimated takes of the entire gillnet fleet were then obtained by applying estimated bycatch rates to total commercial fishing effort, defined as the total mtons of landed kept catch.

Data preparation included converting 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, following the methods outlined in Warden and Orphanides (2008). In 2012, only 2% of observer records were missing latitude and longitude coordinates, while about 3% of commercial fishing records were missing detailed information on fishing locations. Similarly, only 1% of observer records were missing values of mesh size and/or soak duration, while only 1% of commercial fishing records were missing information on mesh size.

Observer data

Observer data were recorded under two survey platforms, NEFOP and ASM. For 2012, 42% and 58% of all hauls observed/monitored were from NEFOP and ASM, respectively. Both survey platforms utilized complete sampling protocols (or complete trips), whereby observers sampled both catch and discard of fishes for biological information (82% of hauls). During complete sampling, observers were not explicitly watching haul backs and so may have missed incidental takes of marine mammals, sea turtles, and/or seabirds. Unlike ASM, NEFOP also utilized limited sampling protocols (or limited trips), whereby the observer explicitly watches the net during haul backs (18% of hauls) reducing the chances of an unnoticed incidental take. It should also be noted that both survey platforms collected environmental, gear, and vessel characteristics during fishing trips. However, ASM only collected a subset of the data required by NEFOP and only monitored vessels with trip declarations into the Northeast multispecies groundfish fishery. As such, 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 analysis section below.

Commercial fishing effort

Vessel trip reports (VTR) and dealer data were used to calculate the total kept landings of commercial fishing vessels operating in the NESG and MAG fisheries. Dealer data were considered a near census of total commercial harvest (Wigley et al. 2008). However, these data do not contain necessary information on gear characteristics and fishing locations. As such, VTR records were augmented with kept landings from the dealer data on a trip-by-trip basis, whenever possible. Otherwise, VTR landings were scaled by an adjustment factor derived from stratification of the dealer data by state and season, thereby ensuring that unmatched VTR landings in any stratum were equal to the unmatched dealer reported landings. This makes the assumption that VTR logbooks are more

representative of the spatiotemporal dynamics of the fishing fleets, whereby dealer data are more representative of commercial fishing effort (i.e., landed kept catch) (Orphanides 2013).

In 2012, a gillnet gear modification study was undertaken to identify the effects of sink gillnet profiles on Atlantic sturgeon (*Acipenser oxyrhynchus*) bycatch in the mid-Atlantic (Fox et al. 2013). During this time, 100% observer coverage was achieved on participating vessels, with no recorded bycatch of marine mammals during the experiment. Vessels participating in the study were also required to submit VTRs, and as such were removed from the analysis because their fishing practices may not have been representative of conventional gillnet fishing effort in the mid-Atlantic.

Analysis

For the purposes of this study, "bycatch" refers to any unintentional take of a protected species that was recorded alive with injuries or dead with varying degrees of decomposition. If an animal exhibited a discrepancy between decomposition state and soak duration (e.g., short soak duration, but severely decomposed animal), then the observation was removed from the analysis. Similarly, unidentified animals were not included in the bycatch estimates. Serious and nonserious injury determinations were made according to the method outlined in Orphanides (2013) for Atlantic white-sided dolphins and harbor seals, as these 2 species have had observations of serious and nonserious injuries within the last 5 years.

The 72°30'W longitude line was used to demarcate the NESG and MAG fisheries (50 CFR Part 229; Waring et al. 2013). As a result, trips landing kept catch in Connecticut, New York, and New Jersey but those fishing east of 72°30'W were included in the NESG fishery. Similarly, trips landing catch east of 72°30'W, but those fishing west of 72°30'W were included in the MAG fishery.

As done in previous years, bycatch rates were estimated with a stratified ratio estimator, whereby strata were defined to reflect the spatiotemporal distributions of marine mammals and commercial gillnetters (Rossman and Merrick 1999). For the NESG fishery, data were stratified temporally by season and spatially by portgroup or management area and were weighted by presence or absence of pingers and groundfish or nongroundfish landings. Data stratification by season, portgroup/management area, and presence/absence of pingers follows the Harbor Porpoise Take Reduction Plan (HPTRP), which explicitly recognizes the seasonality and spatially-varying aspect of harbor porpoise bycatch in the NESG and MAG fisheries. The stratum-specific bycatch rates were weighted by NEFOP-observed groundfish/nongroundfish landings 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. This analysis was accomplished in a two-step process (Orphanides 2013), whereby groundfish and nongroundfish trips were first identified and separated. Then within each trip type, bycatch rates were calculated as a weighted average over pinger use (i.e., pingered or

nonpingered hauls) for each stratum. In other words,

$$\hat{R}_g = \left(\frac{N_p}{N}\right)\frac{y_p}{x_p} + \left(\frac{N_{np}}{N}\right)\frac{y_{np}}{x_{np}} \tag{1}$$

where:

$p =$ pingers and $np =$ no pingers

$\hat{R}_g =$ groundfish or nongroundfish bycatch rate weighted over pinger use

$N =$ observed number of hauls

$y =$ observed number of bycaught animals

$x =$ observed weight of landed kept catch (mtons)

Stratum-specific bycatch rates ($\hat{R}$) were then obtained by averaging over groundfish vs. nongroundfish trips, by using the percentage of NEFOP-observed groundfish vs. nongroundfish landings as weights. In other words,

$$\hat{R} = \sum_g \left(\frac{W_g}{W}\right)\hat{R}_g \tag{2}$$

where:

$W =$ NEFOP-observed kept landings (mtons)

$g \in \{$groundfish, nongroundfish$\}$

This approach was primarily used to account for factors known to influence bycatch of marine mammals (Palka et al. 2008) but which are not easily obtained from commercial fishing records. Albeit, this assumes that the ratio of groundfish to nongroundfish kept landings observed by NEFOP is representative of the true ratio for commercial fishing effort in any stratum.

For the MAG fishery, data were stratified temporally by season, spatially by HPTRP management area, 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:

$$\hat{R} = \frac{y}{x} \tag{3}$$

where:

$\hat{R} =$ stratum bycatch rate

$y =$ observed number of bycaught animals

$x =$ observed weight of landed kept catch (mtons)

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

$$\hat{B} = \hat{R}E \tag{4}$$

Uncertainty around stratum-specific bycatch estimates were obtained by using nonparametric, stratified bootstrapping techniques, with $(1-\alpha)$% confidence intervals being constructed through the bias corrected and accelerated (BCa) method using 5,000 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, so as to account for interdependence among hauls nested within trips (Bisack 2003).

Seasonal subtotal and total bycatch for each species were then obtained through the summation of stratum-specific bycatch estimates. Confidence intervals were constructed around seasonal subtotal and total bycatch estimates by using the BCa method. In addition, 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:

$$fpc = \sqrt{\frac{W-w}{W-1}} \tag{5}$$

where:

W = total kept landings

w = observed kept landings

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

RESULTS

The overall annual observer coverage for the NESG and MAG fisheries in 2012 were 15% and 2%, respectively (Table 1, Figure 1). Observer coverage of the NESG fishery has increased slightly over recent years, while observer coverage of the MAG fishery has remained the same since 2011 and declined since 2010 (Figure 1). Stratum-specific observer coverage rates for the NESG fishery ranged between 0% and 42% (Table 1). Stratum-specific observer coverage rates for the MAG fishery ranged between 2% and 7% (Table 8).

There were 170 observed takes of marine mammals in the NESG fishery for 2012, of which 34 were harbor porpoises, 6 were short-beaked common dolphins, 1 was an Atlantic white-sided dolphin, 91 were gray seals, 37 were harbor seals, and 1 was a Risso's dolphin (Tables 2-7). There were 4 observed takes of marine mammals in the MAG fishery for 2012, of which 2 were harbor porpoises, 1 was a short-beaked common dolphin, and 1 was a gray seal (Table 9). All observed takes of marine mammals in the 2012 NESG and MAG fisheries were mortalities, with no observed serious or nonserious injuries. However, serious and nonserious injuries were determined for Atlantic white-sided dolphins and harbor seals bycaught in the NESG fleet following NOAA Fisheries guidelines (NOAA Fisheries 2012; Orphanides 2013). While no nonserious injuries were observed for harbor seals in 2012, nonserious injuries are still required to be estimated, as nonserious injuries were observed for this species within the last 5 years.

For 2012, it was estimated that there were 277 (CV = 0.59) harbor porpoises, 95 (CV = 0.40) short-beaked common dolphins, 9 (CV = 0.92) Atlantic white-sided dolphins, 542 (CV = 0.19) gray seals, 252 (CV = 0.26) harbor seals, and 6 (CV = 0.87) Risso's dolphins with serious injuries or

mortalities in the NESG fishery (Tables 2-7). For the MAG fishery in 2012, it was estimated that there were 63 (CV = 0.83) harbor porpoises, 15 (CV = 0.93) short-beaked common dolphins, and 14 (CV = 0.98) gray seals with serious injuries or mortalities (Table 9). In addition, there was an estimated 1 harbor seal with a nonserious injury in the NESG fishery for 2012 (Table 6).

Of the observed takes for harbor porpoises and harbor seals, the majority occurred on hauls targeting groundfish within the Gulf of Maine (Figures 2 - 3). Alternatively, short-beaked common dolphin and gray seal bycatch tended to be more associated with gillnet gear targeting skate (*Raja ocellata*) and monkfish (*Lophius americanus*) within southern New England (Figures 2 - 3). This segregation was also reflected in mesh size distributions, with majority of harbor porpoise and harbor seal bycatch occurring in nets with mesh sizes around 6.5 in (Figure 2). This finding is in contrast to short-beaked common dolphin and gray seal bycatch that occurred in gillnets with a majority of mesh sizes around 12 in (Figure 2). Soak durations on observed hauls in the NESG fishery targeting monkfish were generally the longest, averaging over 100 hrs (Figure 4). Skate and flounder (*Pleuronectes ferrugineus*) hauls were the next longest, while dogfish (*Squalus acanthias*) and groundfish hauls were generally the shortest, averaging about 24 hrs (Figure 4). All observed incidental takes of small cetaceans and pinnipeds in the MAG fishery were in nets with 12 in mesh size and targeting monkfish (Table 9).

DISCUSSION

Total annual bycatch of all marine mammal species in the NESG and MAG fisheries has declined since 2011, save for bycatch of short-beaked common dolphins (Figure 5). Though estimated short-beaked common dolphin bycatch is well below the PBR level (Waring et al. 2013), there is high uncertainty around the total estimated takes (i.e., CV = 0.37[1]). It is also interesting to note that since 2008, bycatch of short-beaked common dolphins and gray seals in the MAG fishery occurred only from 2010 onward. While incidental take of short-beaked common dolphins in the mid-Atlantic region has happened in the past (Belden 2007), the frequency of occurrence and magnitude of bycatch may be indicative of a change in the spatial overlap between fishermen and protected species (e.g., range expansion). However, this observation may also be an artifact of low observer coverage that is characteristic of the region.

Harbor porpoises and gray seals have been the most incidentally bycaught species of small cetacean and pinniped, respectively, in the NESG and MAG fisheries since 2008 (Figure 5). Within the last 5 years, harbor porpoise was the only species of small cetacean whose bycatch in gillnets exceeded its PBR, which occurred in 2008 and 2009. Since 2008, annual estimates of harbor porpoise bycatch have declined, and the 2012 estimate of annual bycatch is below PBR (Figure 5). As a result, the most recent 5-year average (2008 - 2012) of harbor porpoise bycatch (i.e., 637) is also below PBR (i.e., 706). However, indications of trends in bycatch of marine mammals within the NESG and MAG fisheries can be difficult to ascertain given the high uncertainty around estimated takes, which results in substantial overlap in confidence intervals across years.

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. Coupled with the rarity of marine mammal interactions with gillnetters, estimates of incidental takes often do not differ significantly per annum resulting

[1] CV for total takes, including New England and mid-Atlantic

in ambiguous bycatch trends. 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 estimated takes. Furthermore, such improvements may aid in more precise risk assessments to determine appropriate mitigation measures to help predict responses in bycatch to changes in marine mammals' or fishers' distributions as a consequence of climate change.

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Table 1. Summaries of observed hauls, observed trips, observed kept landings, prorated commercial kept landings, and observer coverage by season and portgroup/management area for the 2012 New England sink gillnet fishery. Light gray rows indicate strata with marine mammal bycatch. Seasons were defined as "W" winter (January to May), "S" summer (June to August), and "F" fall (September to December).

Season	Portgroup/ Management Area (MA)	Observed Hauls[a]	Observed Trips	Observed Landings (mton)	Commercial Landings (mton)	Observer Coverage (%)
F	East of Cape Cod	350 (11)	83	186.82	1303.65	0.14
F	Mass Bay MA	140 (0)	53	31.14	171.89	0.18
F	Midcoast MA	666 (36)	181	169.42	615.10	0.28
F	North of Boston	318 (8)	88	83.03	408.20	0.20
F	New Hampshire	76 (7)	22	28.17	130.54	0.22
F	Offshore MA	46 (0)	5	24	159.97	0.15
F	Offshore	24 (0)	4	11.47	146.18	0.08
F	Southern Maine	88 (0)	22	25.09	146.91	0.17
F	South of Boston	108 (4)	42	47.44	308.82	0.15
F	South of Cape Cod	145 (84)	29	45.65	1242.34	0.04
F	South Cape MA	49 (10)	13	22.44	329.00	0.07
F	Southern New England	43 (5)	8	14.15	105.89	0.13
F	Stellwagen Bank	382 (26)[b]	93	60.8	226.28	0.27
F	Subtotal	2435 (191)	643	749.62	5294.77	0.14
S	East of Cape Cod	573 (0)	175	488.51	2352.24	0.21
S	Great South Channel	0 (0)	0	0	3.56	0
S	Northern Maine	0 (0)	0	0	2.06	0
S	North of Boston	335 (0)	89	102.83	835.12	0.12
S	New Hampshire	538 (0)	150	201.66	1089.83	0.19
S	Offshore	72 (0)	6	18.64	135.45	0.14
S	Southern Maine	427 (0)	93	168.6	632.88	0.27
S	South of Boston	168 (0)	52	64.23	427.36	0.15
S	South of Cape Cod	144 (0)	30	67.1	1889.11	0.04
S	Subtotal	2257 (0)	595	1111.57	7367.61	0.15
W	Cape Cod Bay	0 (0)	0	0	0.43	0
W	East of Cape Cod	20 (0)	9	5.75	106.71	0.05
W	Great South Channel	0 (0)	0	0	4.15	0
W	Mass Bay MA	286 (38)	120	25.85	64.77	0.40
W	Midcoast MA	212 (13)	64	24	57.97	0.41
W	Northern Maine	0 (0)	0	0	1.16	0
W	North of Boston	79 (9)	40	7.05	50.91	0.14
W	Offshore MA	183 (0)	14	59.18	199.23	0.30
W	Offshore	33 (0)	4	12.6	50.35	0.25
W	Southern Maine	65 (0)	8	16.79	82.78	0.20
W	South of Boston	9 (0)	3	1.49	5.93	0.25
W	South of Cape Cod	2 (0)	1	0.73	227.83	0
W	South Cape MA	270 (19)	75	207.49	1591.08	0.13
W	Southern New England	539 (29)	102	276.19	2129.41	0.13
W	Stellwagen Bank	1213 (101)	290	105.85	254.80	0.42
W	Subtotal	2911 (209)	730	742.97	4827.51	0.15
	Total	7603 (400)	1968	2604.16	17489.89	0.15

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

[b] 4 hauls in this stratum could not be assigned to complete or limited.

Table 2. Observed number of takes, estimated bycatch rates, estimated takes, coefficient of variation (CV), and lower (L) and upper (U) bounds on 95% confidence intervals (CI) of harbor porpoise (*Phocoena phocoena phocoena*) bycatch in the New England sink gillnet fishery for 2012, by season and portgroup/management area. Seasons were defined as "W" winter (January to May), "S" summer (June to August), and "F" fall (September to December).

Season	Portgroup/ Management Area (MA)	Observed Takes	Bycatch Rate	Estimated Takes	CV	95% CI L	95% CI U
F	Mass Bay MA	1	0.032	5.50	0.95	1	29
F	Midcoast MA	8	0.047	28.91	0.37	10	66
F	North of Boston	3	0.038	15.51	0.53	4	43
F	South Cape MA	2	0.160	52.64	2.79	2	413
F	Stellwagen Bank MA	1	0.017	3.85	0.87	1	23
F	Subtotal	15	-	106.41	1.39	31	460
S	Southern Maine	1	0.006	3.80	0.87	1	16
S	Subtotal	1	-	3.80	0.87	1	16
W	Mass Bay MA	2	0.077	4.99	0.55	2	17
W	Midcoast MA	2	0.083	4.81	0.63	2	18
W	North of Boston	1	0.144	7.33	1.04	1	39
W	South Cape MA	3	0.040	63.64	0.76	3	227
W	Southern New England MA	3	0.033	70.27	0.63	6	242
W	Stellwagen Bank MA	7	0.063	16.05	0.30	7	32
W	Subtotal	18	-	167.09	0.43	65	373
All	Total	34	-	277.30	0.59	122	603

Table 3. Observed number of takes, estimated bycatch rates, estimated takes, coefficient of variation (CV), and lower (L) and upper (U) bounds on 95% confidence intervals (CI) of short-beaked common dolphin (*Delphinus delphis delphis*) bycatch in the New England sink gillnet fishery for 2012, by season and portgroup/management area. Seasons were defined as "W" winter (January to May), "S" summer (June to August), and "F" fall (September to December).

Season	Portgroup/ Management Area (MA)	Observed Takes	Bycatch Rate	Estimated Takes	CV	95% CI L	95% CI U
F	South of Cape Cod	1	0.021	26.09	0.96	1	115
F	South Cape MA	1	0.043	14.15	1.25	1	96
F	Southern New England MA	2	0.413	43.73	0.44	2	44
F	Subtotal	4	-	83.97	0.44	39	247
W	South Cape MA	1	0.003	4.77	0.93	1	29
W	Southern New England MA	1	0.003	6.39	0.86	1	32
W	Subtotal	2	-	11.16	0.68	2	51
All	Total	6	-	95.13	0.40	47	244

Table 4. Observed number of takes, estimated bycatch rates, estimated takes, coefficient of variation (CV), and lower (L) and upper (U) bounds on 95% confidence intervals (CI) of Atlantic white-sided dolphin (*Lagenorhynchus acutus*) bycatch in the New England sink gillnet fishery for 2012, by season and portgroup/management area. Seasons were defined as "W" winter (January to May), "S" summer (June to August), and "F" fall (September to December).

Season	Portgroup/ Management Area (MA)	Observed Takes	Bycatch Rate	Estimated Takes	CV	95% CI L	95% CI U
S	North of Boston	1	0.011	9.19	0.92	1	53
S	Subtotal	1	-	9.19	0.92	1	53
All	Total	1	-	9.19[a]	0.92	1	53

[a] Total estimated takes include 1 serious injury for 2012.

Table 5. Observed number of takes, estimated bycatch rates, estimated takes, coefficient of variation (CV), and lower (L) and upper (U) bounds on 95% confidence intervals (CI) of Atlantic gray seal (*Halichoerus grypus grypus*) bycatch in the New England sink gillnet fishery for 2012, by season and portgroup/management area. Seasons were defined as "W" winter (January to May), "S" summer (June to August), and "F" fall (September to December).

Season	Portgroup/ Management Area (MA)	Observed Takes	Bycatch Rate	Estimated Takes	CV	95% CI L	95% CI U
F	East of Cape Cod	5	0.026	33.89	0.62	7	116
F	Subtotal	5	-	33.89	0.62	7	116
S	East of Cape Cod	37	0.077	181.12	0.24	108	317
S	North of Boston	3	0.032	26.72	0.52	8	72
S	Offshore Port	1	0.054	7.31	1.29	1	51
S	Subtotal	41	-	215.15	0.24	139	361
W	East of Cape Cod	2	0.257	27.42	1.74	2	196
W	Mass Bay MA	1	0.039	2.53	0.78	1	14
W	South Cape MA	12	0.032	50.91	0.47	14	118
W	Southern New England MA	18	0.086	183.13	0.34	83	362
W	Stellwagen Bank MA	12	0.115	29.30	0.22	16	49
W	Subtotal	45	-	293.29	0.29	165	510
All	Total	91	-	542.33	0.19	376	789

Table 6. Observed number of takes, estimated bycatch rates, estimated takes, coefficient of variation (CV), and lower (L) and upper (U) bounds on 95% confidence intervals (CI) of harbor seal (*Phoca vitulina concolor*) bycatch in the New England sink gillnet fishery for 2012, by season and portgroup/management area. Seasons were defined as "W" winter (January to May), "S" summer (June to August), and "F" fall (September to December).

Season	Portgroup/ Management Area (MA)	Observed Takes	Bycatch Rate	Estimated Takes	CV	95% CI L	95% CI U
F	Midcoast MA	4	0.024	14.76	0.42	4	35
F	North of Boston	2	0.024	9.80	0.66	2	33
F	Southern Maine	1	0.042	6.17	0.90	1	25
F	South of Cape Cod	1	0.026	32.30	1.14	1	150
F	Subtotal	8	-	63.03	0.62	18	186
S	North of Boston	8	0.085	70.99	0.45	25	173
S	New Hampshire	8	0.040	43.59	0.34	21	89
S	Offshore Port	1	0.054	7.31	1.43	1	47
S	Southern Maine	5	0.030	18.99	0.38	7	41
S	Subtotal	22	-	140.88	0.28	80	240
W	Midcoast MA	2	0.083	4.81	0.59	2	17
W	South Cape MA	1	0.003	4.77	0.93	1	22
W	Southern New England MA	1	0.015	31.94	1.02	1	184
W	Stellwagen Bank MA	3	0.029	7.39	0.44	3	20
W	Subtotal	7	-	48.91	0.73	11	202
All	Total	37	-	252.82[a]	0.26	153	420

[a] Total estimated takes include 1 nonserious injury for 2012, resulting in 252 (CV = 0.26) estimated serious injuries and total mortalities.

Table 7. Observed number of takes, estimated bycatch rates, estimated takes, coefficient of variation (CV), and lower (L) and upper (U) bounds on 95% confidence intervals (CI) of Risso's dolphin (*Grampus griseus*) in the New England sink gillnet fishery for 2012, by season and portgroup/management area. Seasons were defined as "W" winter (January to May), "S" summer (June to August), and "F" fall (September to December).

Season	Portgroup/ Management Area (MA)	Observed Takes	Bycatch Rate	Estimated Takes	CV	95% CI L	95% CI U
W	Southern New England MA	1	0.003	6.39	0.87	1	28
W	Subtotal	1	-	6.39	0.87	1	28
All	Total	1	-	6.39	0.87	1	28

Table 8. Summaries of observed hauls, observed trips, observed kept landings, prorated commercial kept landings, and observer coverage by season, portgroup/management area, mesh size, and soak duration for strata with bycatch in the 2012 mid-Atlantic gillnet fishery.

Season	Portgroup/ Management Area (MA)	Mesh Size (in)	Soak Duration (hrs)	Observed Hauls[a]	Observed Trips	Observed Landings (mton)	Commercial Landings (mton)	Observer Coverage
Dec-Apr	Waters off New Jersey	≥ 7	> 72	51 (19)	14	20.77	290.56	0.07
Dec-Apr	Waters off New Jersey	≥ 7	≤ 72	20 (12)	8	8.34	412.14	0.02
Dec-Jan	Waters off New Jersey	≥ 7	> 72	40 (8)	13	15.22	224.22	0.07

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

Table 9. Observed number of takes, estimated bycatch rates, estimated takes, coefficient of variation (CV), and lower (L) and upper (U) bounds on 95% confidence intervals of estimated marine mammal bycatch in the mid-Atlantic gillnet fishery for 2012, by season, portgroup/management area, mesh size, and soak duration.

Species	Season	Portgroup/ Management Area (MA)	Mesh Size (in)	Soak Duration (hrs)	Observed Takes	Bycatch Rate	Estimated Takes	CV	95% CI L	95% CI U
Harbor porpoise	Dec-Apr	Waters off New Jersey	≥ 7	>72	1	0.048	13.95	0.98	1	73
	Dec-Apr	Waters off New Jersey	≥ 7	≤ 72	1	0.120	49.46	1.03	1	244
	All	Total	All	All	2	-	63.41	0.83	2	254
Short-beaked common dolphin	Dec-Jan	Waters off New Jersey	≥ 7	>72	1	0.066	14.80	0.93	1	65
Gray seal	Dec-Apr	Waters off New Jersey	≥ 7	>72	1	0.048	13.95	0.98	1	72

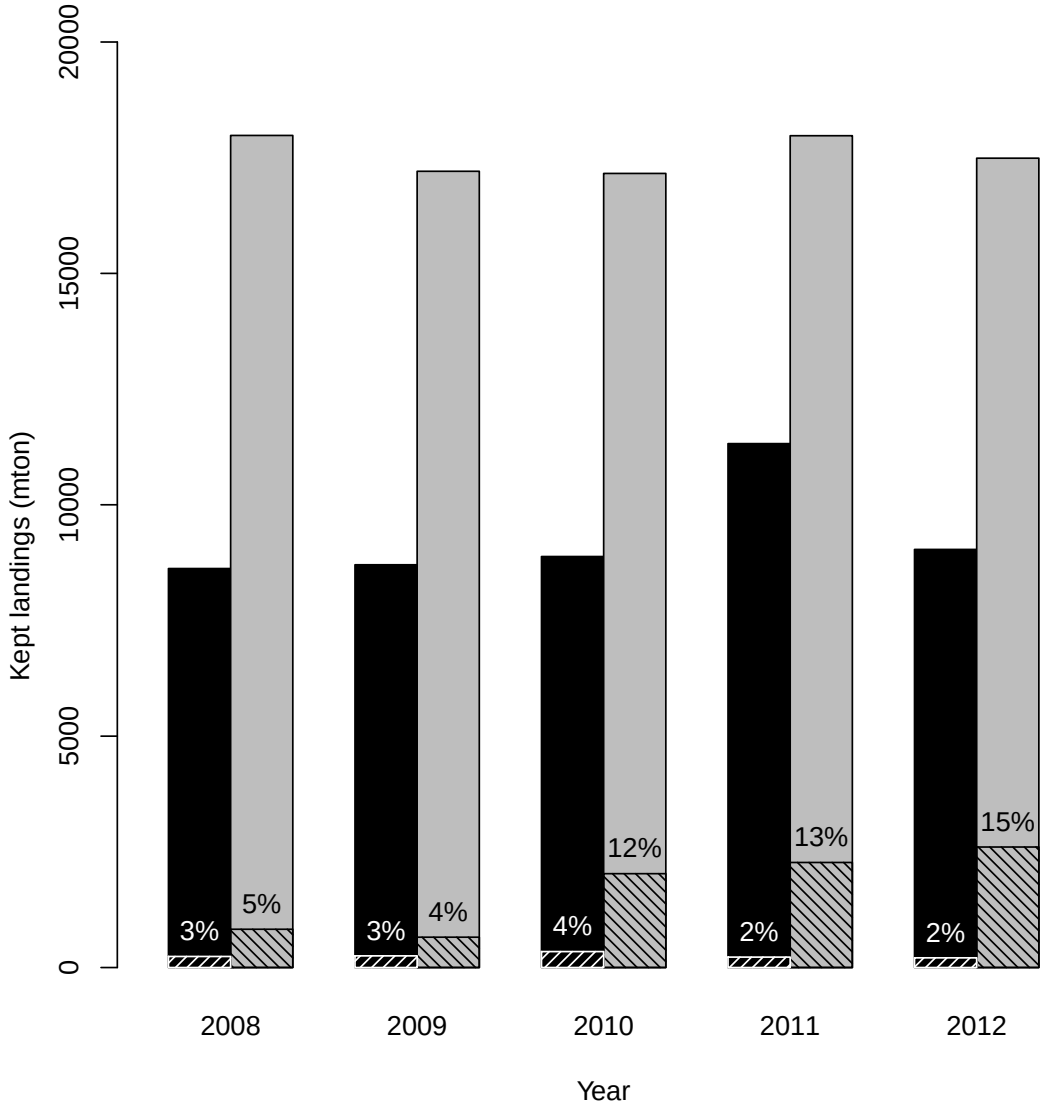

Figure 1. Annual time series of the amount of commercial fishing effort (i.e., kept landings) for the New England sink (gray) and mid-Atlantic (black) gillnet fisheries. Hatched areas indicate the proportion (as indicated by the percentage above the hatched areas) of total commerical fishing effort observed by the Northeast Fishery Observer and Northeast Fishery At-Sea Monitoring Programs.

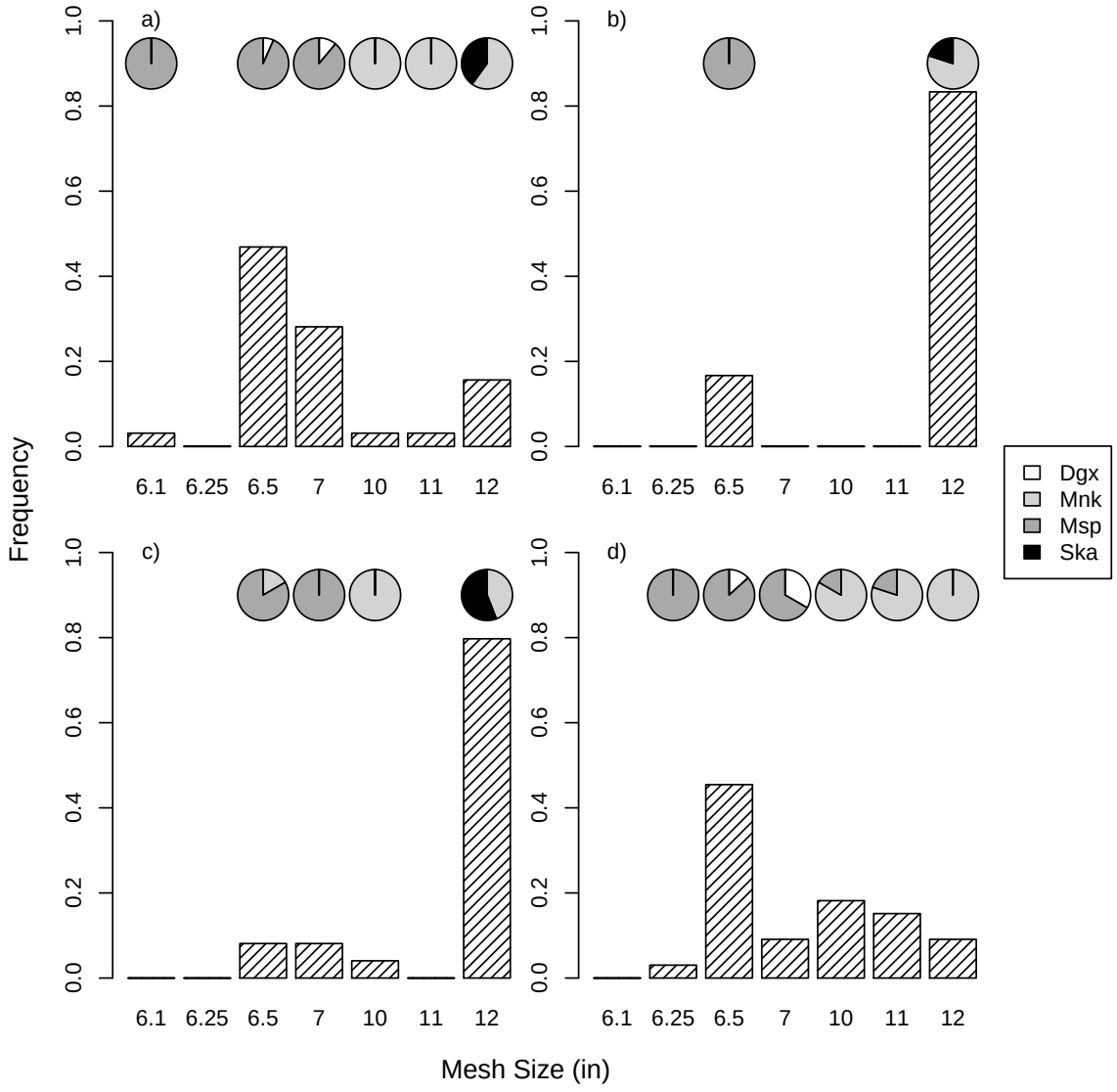

Figure 2. Mesh size (in) distributions of observed hauls in the New England sink gillnet fishery with marine mammal bycatch during 2012. a) harbor porpoise (*Phocoena phocoena phocoena*), b) short-beaked common dolphin (*Delphinus delphis delphis*), c) gray seal (*Halichoerus grypus grypus*), and d) harbor seal bycatch (*Phoca vitulina concolor*). Pie charts above bars refer to composition of live weight of landed kept catch for that particular mesh size, aggregated by Fishery Management Plan. Dgx = Dogfish (*Squalus acanthias*), Mnk = Monkfish (*Lophius americanus*), Msp = Multispecies groundfish and Ska = Skate (*Raja ocellata*).

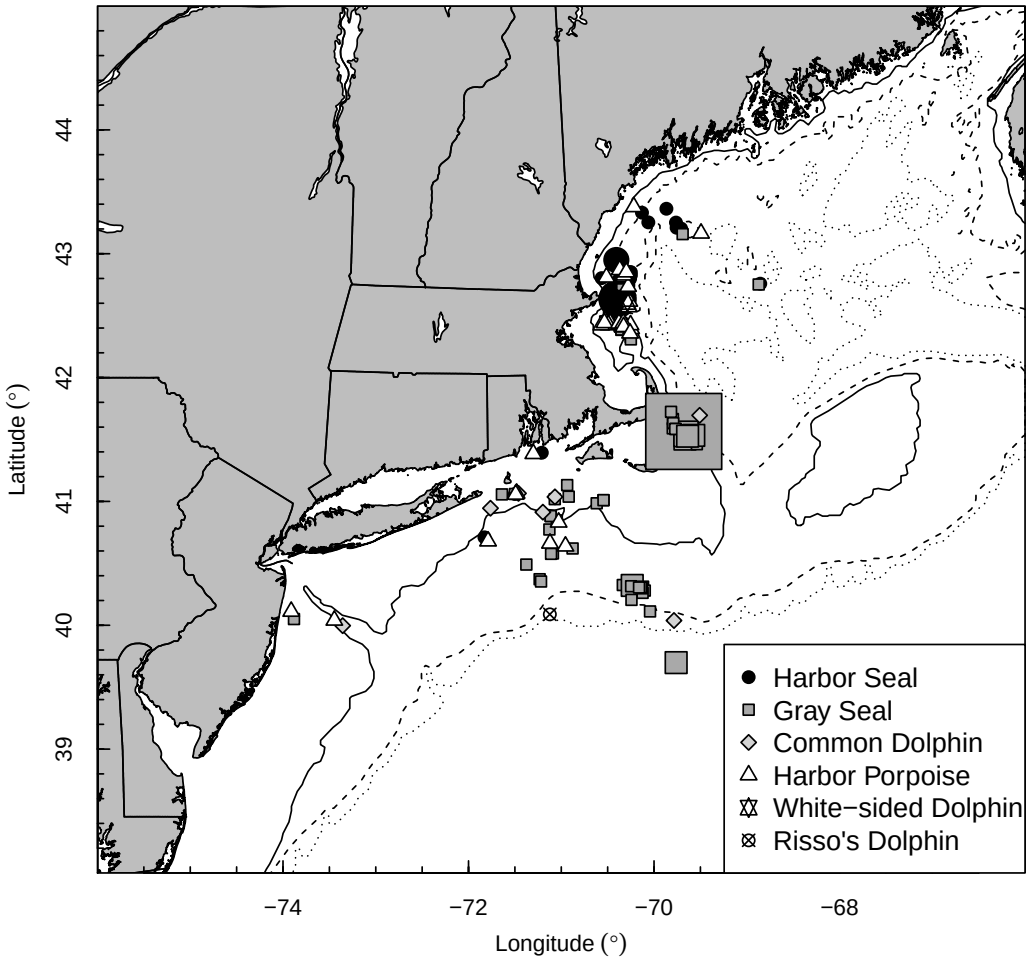

Figure 3. Location of observed hauls with marine mammal bycatch in the New England sink and mid-Atlantic gillnet fisheries for 2012. Points are scaled by the magnitude of bycatch per haul. Solid line indicates the 50m depth isocline, dashed line indicates the 100m depth isocline, and the dotted line indicates the 200m isocline. Marine mammal species include harbor seal (*Phoca vitulina concolor*), gray seal (*Halichoerus grypus grypus*), short-beaked common dolphin (*Delphinus delphis delphis*), harbor porpoise (*Phocoena phocoena phocoena*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), and Risso's dolphin (*Grampus griseus*).

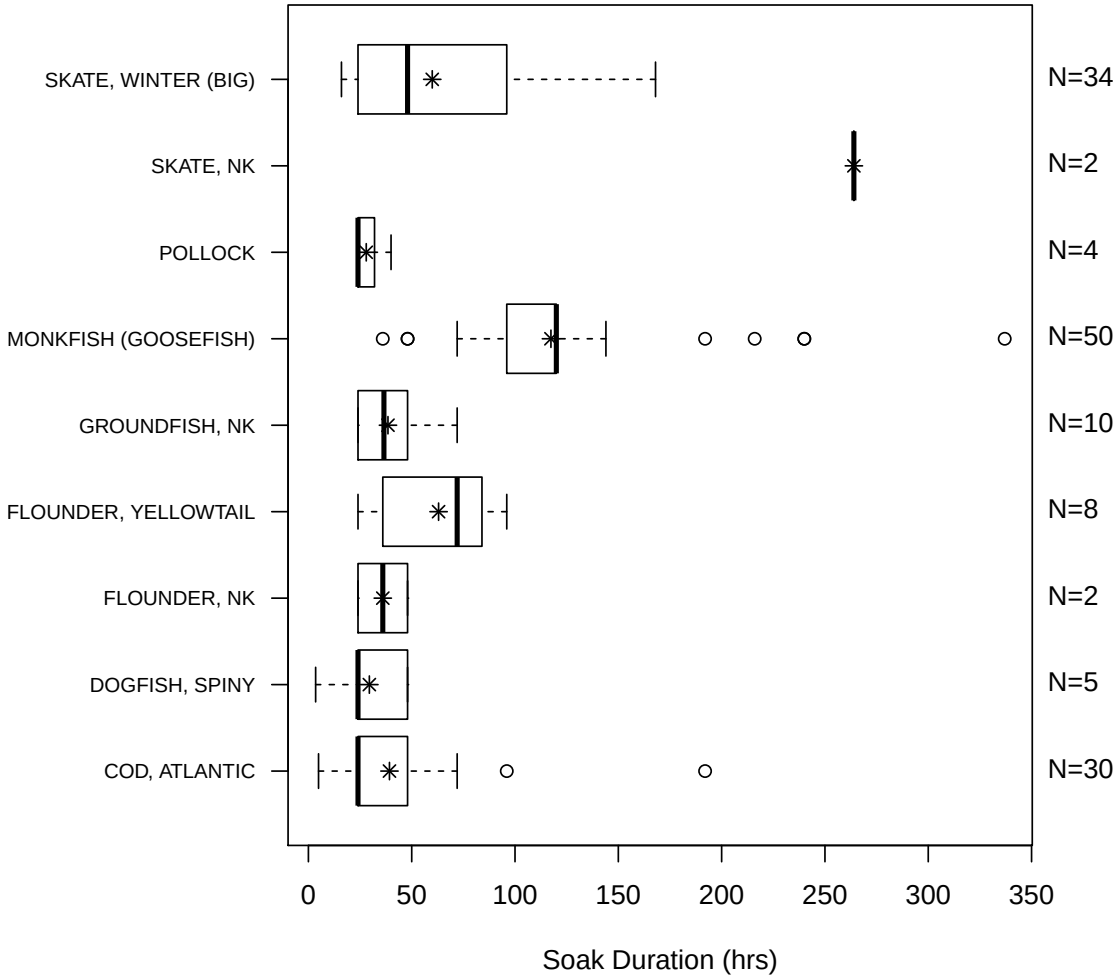

Figure 4. Boxplots of soak duration (hrs) by target fish species of observed hauls in the New England sink gillnet fishery for 2012. Only those target fish species with marine mammal bycatch are shown. Sample sizes are shown to the far right of the boxplots. Stars indicate the average, circles indicate outliers, and NK refers to an unknown species. Target fish species include winter skate (*Raja ocellata*), pollock (*Pollachius virens*), monkfish (*Lophius americanus*), yellowtail flounder (*Pleuronectes ferrugineus*), spiny dogfish (*Squalus acanthias*), and Atlantic cod (*Gadus morhua*).

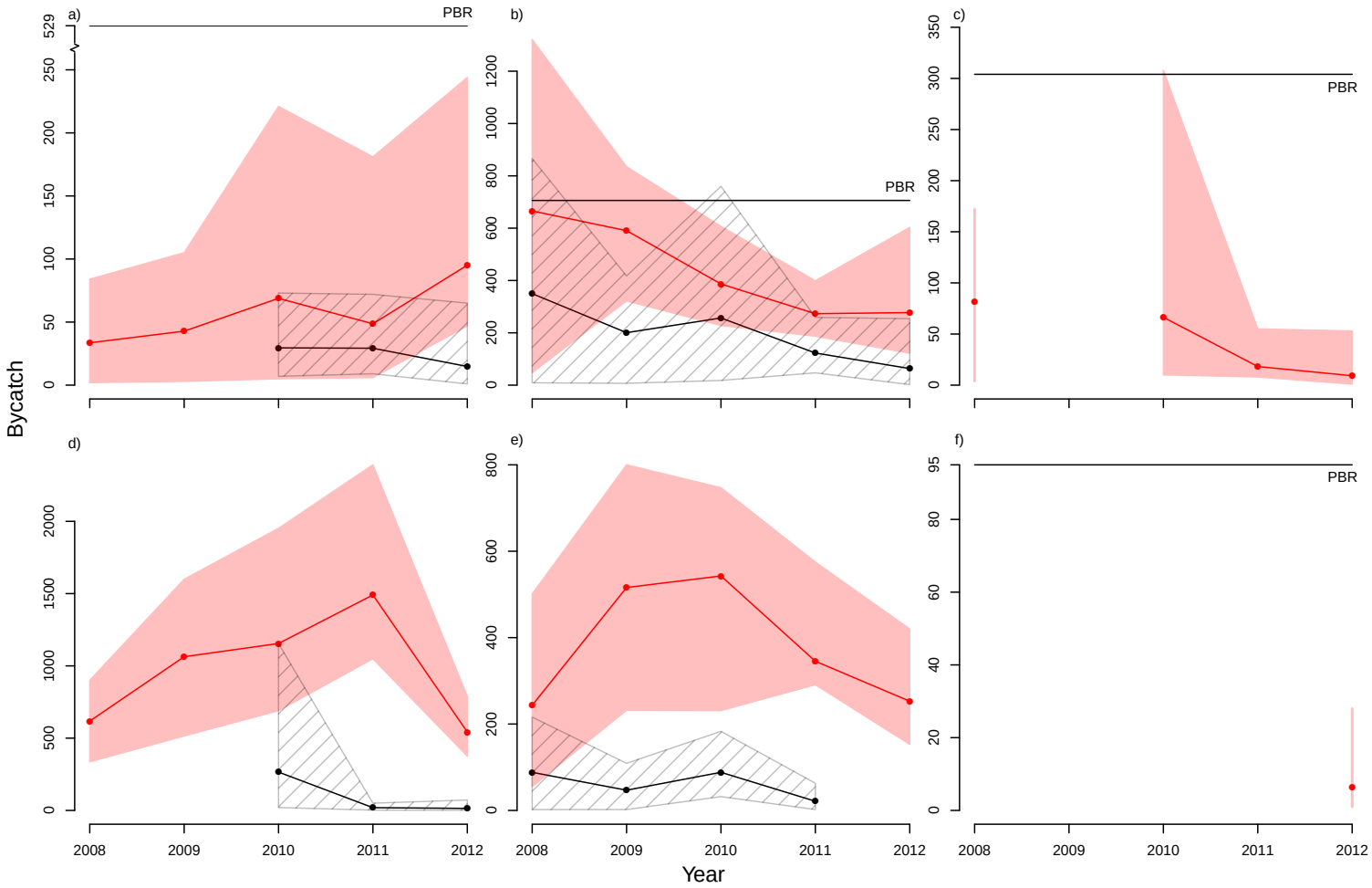

Figure 5. Total estimated bycatch and 95% confidence intervals from 2008-2012 for the New England sink (red, pink) and mid-Atlantic (black, gray hatched) gillnet fisheries. Solid, black, horizontal lines denote the Potential Biological Removal (PBR) from the most recent Stock Assessment Report (Waring et al. 2013). a) short-beaked common dolphin *Delphinus delphis delphis* (PBR = 529), b) harbor porpoise *Phocoena phocoena phocoena* (PBR = 706), c) Atlantic white-sided dolphin *Lagenorhynchus acutus* (PBR = 304), d) gray seal *Halichoerus grypus grypus* (PBR = NA), e) harbor seal *Phoca vitulina concolor* (PBR = NA), and f) Risso's dophin *Grampus griseus* (PBR = 95).

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