Northeast Fisheries Science Center Reference Document 22-05

Estimates of Cetacean and Pinniped Bycatch in the 2019 New England Sink and Mid-Atlantic Gillnet Fisheries

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Estimates of cetacean and pinniped bycatch in the 2019 New England sink and Mid-Atlantic gillnet fisheries

by Kristin Precoda[1], Christopher D. Orphanides[2]

[1] Integrated Statistics, 16 Sumner Street, Woods Hole, MA 02543
[2] NOAA Fisheries Service, Northeast Fisheries Science Center, 28 Tarzwell Drive, Narrangansett, RI 02882

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This report provides estimated bycatch of 6 species of small cetaceans and pinnipeds bycaught in the New England sink gillnet (NESG) and Mid-Atlantic gillnet (MAG) fisheries. The bycatch estimation methodology approach used for these data differs only slightly from that used in prior year estimates; changes are noted in the Methods section. For additional details on the bycatch estimation methodology, please refer to Orphanides and Hatch (2017).

Bycatch estimates in New England were performed with a stratified ratio estimation approach using the seasons, portgroups, and management areas used in recent years (Orphanides and Hatch 2017). This time-area stratification approach was originally developed for the estimation of harbor porpoise bycatch but has been applied to bycatch of other small cetaceans and pinnipeds since 1995 (Blaylock et al. 1995) because bycatch for other species is also largely driven by spatial and temporal patterns. The observer coverage for these New England strata was 12% (Table 1). The 2019 serious injuries and total mortalities in the NESG fishery were 5 (coefficient of variation [CV] = 0.68) common dolphins (*Delphinus delphis delphis*), 5 (CV = 0.7) Risso's dolphins (*Grampus griseus*), 195 (CV = 0.22) harbor porpoise (*Phocoena phocoena phocoena*), 163 (CV = 0.19) harp seals (*Pagophilus groenlandicus*), 316 (CV = 0.15) harbor seals (*Phoca vitulina vitulina*), and 2019 (CV = 0.17) gray seals (*Halichoerus grypus atlantica*). The NESG estimates are based on observed bycatch consisting of 1 common dolphin, 1 Risso's dolphin, 33 harbor porpoise, 34 harp seals, 59 harbor seals, and 251 gray seals (Tables 2-7). Additional bycatch included several animals that could not be identified to species and therefore could not be included in species-specific bycatch estimates, including 2 unidentified dolphins and 22 unidentified seals. The percent of New England gillnet hauls containing the proper number of pingers with regard to the 2010 Harbor Porpoise Take Reduction Plan (HPTRP) was 66% in 2019. This percent is based on the correct number of pingers used, not the pingers' functionality (Table 8). Management areas are shown in Figure 1. For the purpose of estimating bycatch in winter in the North of Boston portgroup, that portgroup was merged with the Mid-Coast management area because few winter hauls were observed from the North of Boston portgroup and because the observed hauls were geographically closest to observed hauls from the Mid-Coast management area. This impacted bycatch estimates only for harbor porpoise. Similarly, the South Maine portgroup was merged with the Mid-Coast management area for estimating bycatch in winter; this only affected harp seal estimates. Finally, to estimate fall bycatch, the Offshore Closure portgroup was merged with the S. Maine portgroup; only harbor seal estimates were affected by this.

The Mid-Atlantic ratio estimator stratification was done as in recent years by area, mesh size, soak duration, and season coinciding with previous bycatch estimates in this region (Orphanides and Hatch 2017). The spatial stratifications for 2019 Mid-Atlantic bycatch included the Waters off New Jersey (NJ) and Southern Mid-Atlantic (SMA) HPTRP management areas (Figure 1). Observer coverage in the Mid-Atlantic by state averaged 13% (Table 9), and observer coverage for the bycatch strata ranged from 10% to 20% as calculated by metric tons landed (Table 10). Seasons used were based on current and observed historical bycatch from 1994-2019 and were Dec.-Mar. (NJ) and Feb.-Mar. (SMA) for common dolphin; Jan.-May (NJ) and Jan.-Apr. (SMA) for harbor porpoise; Jan.-Apr. for harp seal (only observed and estimated in NJ); Jan.-May for harbor seal (only observed and estimated in NJ); and Jan.-May (NJ) and Jan.-Apr. (SMA) for gray seal.

The 2019 total serious injuries and mortalities in the MAG fishery were 13 (CV = 0.51) harbor porpoises, 20 (CV = 0.56) common dolphins, 18 (CV = 0.40) gray seals, 17 (CV = 0.35) harbor seals, and 29 (CV = 0.84) harp seals (Table 11). The MAG estimates are based on observed bycatch consisting of 2 harbor porpoises, 3 common dolphins, 3 harp seals, 3 harbor seals, and 3 gray seals (Table 11, Figure 2). There was also 1 observed incidental take of a bottlenose dolphin

(*Tursiops truncatus truncatus*) from coastal stocks, but bycatch estimates for this animal are not included in this report and will be reported elsewhere. One unidentified dolphin take in the MAG fishery was excluded from further analysis. Adherence to the HPTRP regulations on observed hauls in the 2019 MAG fishery was relatively low for large mesh gillnets (44%) and higher for small mesh gillnets (65%) (Table 12). Observer coverage by fishery and year, and observed and estimated serious injuries and mortalities, are summarized for the 5-year period of 2015-2019 in Table 13 to correspond with tables provided in the Stock Assessment Reports.

METHODS

The bycatch estimation methodology is based on Orphanides and Hatch (2017). Modifications to the methodology this year include the following:

a) The bycatch estimates and confidence intervals on the bycatch estimates are calculated by adding the observed bycatch to the product of the estimated bycatch rate per metric ton of landings and the total unobserved landings. That is,

$$Estimated\ bycatch = (observed\ bycatch) + (bycatch\ rate) \times (total\ landings - observed\ landings)$$

In prior years, the bycatch estimate and confidence intervals were calculated by multiplying the estimated bycatch rate per metric ton of landings by the total reported landings:

$$Estimated\ bycatch = (bycatch\ rate) \times (total\ landings)$$

This change was made because the observed bycatch is a known quantity, with no uncertainty, and the confidence intervals should only reflect the uncertainty in the estimated (unobserved) bycatch.

b) The finite correction factor was applied when observer coverage exceeded 10% of the trips with effort reported; previously, it was applied when observer coverage exceeded 10% of the metric tons landed.

c) Rounding was performed after calculations of bycatch rates, whereas in previous years, rounding was done at each step so the reader could calculate bycatch estimates from tables in the report. Rounding at each step was useful prior to the incorporation of a weighting scheme that adjusts for increased groundfish coverage with the At-Sea-Monitoring program (Orphanides and Hatch 2017). The upper and lower confidence interval bounds were rounded to the next larger and next smaller integer respectively, so as not to narrow the confidence interval below its nominal 95% level; previously, both confidence interval bounds were rounded to their nearest integers.

d) When the weighting for the presence or absence of pingers within a stratum in the NESG fishery is calculated, occasionally there are hauls or trips for which it is unknown whether pingers were used. These hauls and trips were excluded from the weighting calculation unless there are no hauls or trips within a stratum for which pinger usage was known; in that case, it was assumed pingers were not used, as excluding those hauls or trips would mean the stratum would have no hauls or trips. When the weighting was

applied to obtain the bycatch rate, hauls or trips with no information on the presence or absence of pingers were treated as if they had no pingers. In 2019, there was 1 trip with 4 hauls with unknown pinger use. This trip was in Southern New England in April and affected estimates for Risso's dolphin, harbor porpoise, harp seal, harbor seal, and gray seal. In previous years, weights were calculated when pingers were present, when pingers were absent, and when pinger use was unknown, and were applied to hauls or trips whose pinger status matched 1 of these 3 cases. The weights for pingers present and pingers absent did not sum to 1 in prior years if pinger use was unknown for some hauls or trips within a stratum, resulting in unpredictable underweighting.

e) The calculation for the CV for the 5-year mean estimates has been revised in alignment with method 1 in the Guidelines for Preparing Stock Assessment Reports Pursuant to Section 117 of the Marine Mammal Protection Act (2016). The guidelines suggest that the variance estimate for the 5-year summary should be calculated including only years with non-zero variance estimates, while the mean for the 5-year summary should include all years. This results in larger CVs than when all years are included in the variance estimate, as has previously been done.

Missing values in the observer data are filled in where possible for latitude and longitude, mesh size, number of nets, total gear length, net length, haul duration, and soak duration. The steps that are followed, which are similar to those outlined in Warden & Orphanides (2008), are given in order below. This set of steps has been used in previous years but not thoroughly documented.

a) If there is a preceding haul on the same trip and the immediately preceding haul has a nonmissing value, use that to fill in the missing value on the focus haul.
b) If there is a following haul on the same trip and the immediately following haul has a nonmissing value, use that to fill in the missing value on the focus haul.
c) For longitude & latitude only: Fill in the missing value on the focus haul with the median for that variable over hauls from the same vessel, gear type, year, month, and statistical area.
d) For mesh size, number of nets, total gear length, net length, haul duration, and soak duration:
    i. If possible, fill in the missing value on the focus haul with the median for that variable over hauls from the same vessel, gear type, year, and month.
    ii. If the value is still missing, and if possible, fill in the missing value on the focus haul with the median for that variable over hauls from the same vessel, gear type, and year.
    iii. If the value is still missing, and if possible, fill in the missing value on the focus haul with the median for that variable over hauls from the same vessel and year.

We also explored alternate stratifications for harp seal, harbor seal, and gray seal using strata defined by Ecological Production Unit (EPU; Ecosystem Assessment Program 2012), large vs. small mesh size, and quarter of the calendar year. Two sets of EPUs were used: the first set was Georges Bank (GB), Gulf of Maine (GOM), and Mid-Atlantic Bight (MAB), and the second set was GB, GOM, MAB north of 38.7833°N, and MAB south of 38.7833°N. Results are given in the appendix. With both sets of EPUs total bycatch estimates fell within the confidence intervals derived with the stratifications shown elsewhere in this report. We plan to continue exploring the

most appropriate stratification scheme for seals and may apply an alternate stratification scheme for future bycatch estimation.

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TABLES

Table 1. Summaries of observed hauls, observed trips, observed landings, prorated commercial landings, and observer coverage by season and port group (P) or management area (MA) for the 2019 New England sink gillnet fishery. Seasons were defined as "W" (winter; January-May), "S" (summer; June-August), and "F" (fall; September-December).

Season	Area	Observed Hauls[a]	Observed Trips	Commercial Trips	Observed Landings (mt)	Commercial Landings (mt)	Observer Coverage (mt)	Observer Coverage (trips)
W	Cape Cod South (MA)	78 (58)	24	337	43.70	725.32	0.06	0.07
W	Cashes Ledge (MA)	0 (0)	0	1	0.00	1.48	0.00	0.00
W	East of Cape Cod (P)	15 (4)	4	42	12.57	172.79	0.07	0.10
W	Massachusetts Bay (MA)	0 (0)	0	29	0.00	1.34	0.00	0.00
W	Mid-Coast (MA)	140 (22)	38	104	25.92	81.59	0.32	0.37
W	New Hampshire (P)	0 (0)	0	2	0.00	3.03	0.00	0.00
W	Offshore (MA)	105 (44)	13	23	35.86	68.49	0.52	0.57
W	Offshore (P)	32 (16)	4	9	9.45	21.15	0.45	0.44
W	South of Boston (P)	0 (0)	0	1	0.00	0.03	0.00	0.00
W	South of Cape Cod (P)	14 (0)	7	75	1.18	223.98	0.01	0.09
W	Southern New England (MA)	416 (179)	109	556	414.39	2020.65	0.21	0.20
W	Stellwagen Bank (MA)	83 (25)	21	86	9.25	38.47	0.24	0.24
W	Subtotal	883 (348)	220	1265	552.32	3358.32	0.16	0.17
S	East of Cape Cod (P)	179 (4)	72	1278	241.02	3208.07	0.08	0.06
S	New Hampshire (P)	203 (0)	53	314	112.25	533.84	0.21	0.17
S	North of Boston (P)	47 (0)	17	163	25.25	260.15	0.10	0.10
S	Offshore (P)	48 (0)	9	62	23.40	212.11	0.11	0.15
S	South of Boston (P)	77 (0)	19	132	17.60	125.61	0.14	0.14
S	South of Cape Cod (P)	202 (0)	53	649	58.63	1397.65	0.04	0.08
S	Southern Maine (P)	125 (0)	25	144	47.84	263.62	0.18	0.17
S	Subtotal	881 (4)	248	2742	525.98	6001.05	0.09	0.09
F	Cape Cod South (MA)	29 (19)	9	69	24.44	227.04	0.11	0.13
F	East of Cape Cod (P)	122 (101)	47	646	158.95	1685.51	0.09	0.07
F	Massachusetts Bay (MA)	1 (0)	1	2	0.06	0.17	0.33	0.50
F	Mid-Coast (MA)	302 (44)	78	239	78.91	308.28	0.26	0.33
F	New Hampshire (P)	23 (8)	7	41	5.88	34.30	0.17	0.17
F	North of Boston (P)	15 (0)	7	23	5.31	47.52	0.11	0.30
F	Offshore (P)	0 (0)	0	12	0.00	36.02	0.00	0.00
F	South of Boston (P)	16 (6)	5	41	5.99	47.55	0.13	0.12
F	South of Cape Cod (P)	297 (52)	64	384	122.50	908.30	0.13	0.17
F	Southern Maine (P)	75 (22)	9	36	41.32	104.31	0.40	0.25
F	Southern New England (MA)	29 (12)	11	80	31.54	263.91	0.12	0.14
F	Stellwagen Bank (MA)	31 (2)	11	20	4.66	10.56	0.44	0.55

Season	Area	Observed Hauls[a]	Observed Trips	Commercial Trips	Observed Landings (mt)	Commercial Landings (mt)	Observer Coverage (mt)	Observer Coverage (trips)
F	Subtotal	940 (266)	249	1593	479.57	3673.47	0.13	0.16
	Total	2704 (618)	717	5600	1557.88	13032.84	0.12	0.13

[a] Parentheses indicate the number of limited hauls out of the total (i.e., complete + limited). During complete sampling, observers do not explicitly watch haulbacks and may fail to see bycatch of marine mammals that fall out of the net prior to being hauled on board. During limited sampling, the observer watches the net during haulbacks, reducing the chance of unnoticed bycatch.

Table 2. Observed number of bycatch, estimated bycatch rates per metric ton landed, estimated bycatch, coefficient of variation (CV), and lower (L) and upper (U) limits on 95% confidence intervals (CI) of common dolphin (*Delphinus delphis delphis*) bycatch in the New England sink gillnet fishery for 2019 by season and port group (P) or management area (MA). The season was defined as "F" (fall; September-December).

Season	Area	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
F	South of Cape Cod (P)	1	0.005	4.97	0.68	1	21
F	Subtotal	1	-	4.97	0.68	1	21
	Total	1	-	4.97	0.68	1	21

Table 3. Observed number of bycatch, estimated bycatch rates per metric ton landed, estimated bycatch, coefficient of variation (CV), and lower (L) and upper (U) limits on 95% confidence intervals (CI) of Risso's dolphin (*Grampus griseus*) bycatch in the New England sink gillnet fishery for 2019 by season and portgroup (P) or management area (MA). The season was defined as "W" (winter; January-May).

Season	Area	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Southern New England (MA)	1	0.003	5.20	0.7	1	25
W	Subtotal	1	-	5.20	0.7	1	25
	Total	1	-	5.20	0.7	1	25

Table 4. Observed number of bycatch, estimated bycatch rates per metric ton landed, 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 2019 by season and portgroup (P) or management area (MA). Seasons were defined as "W" (winter; January-May), "S" (summer; June-August), and "F" (fall; September-December).

Season	Area	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Cape Cod South (MA)	4	0.09	65.54	0.58	17	178
W	Mid-Coast (MA)	7	0.262	21.57	0.44	8	76
W	Offshore (MA)	2	0.054	3.76	0.27	2	9
W	Offshore (P)	1	0.106	2.24	0.37	1	5
W	Southern New England (MA)	6	0.016	30.92	0.34	14	69
W	Subtotal	20	-	124.04	0.30	63	233
S	North of Boston (P)	1	0.034	9.05	0.99	1	58
S	Offshore (P)	1	0.043	9.07	0.80	1	38
S	Southern Maine (P)	3	0.06	15.88	0.41	6	39
S	Subtotal	5	-	34.00	0.39	13	77
F	Cape Cod South (MA)	1	0.043	9.77	1.57	1	74
F	Mid-Coast (MA)	7	0.089	27.34	0.25	15	51
F	Subtotal	8	-	37.12	0.42	18	99
	Total	33	-	195.15	0.22	120	306

Table 5. Observed number of bycatch, estimated bycatch rates per metric ton landed, 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 2019 by season and portgroup (P) or management area (MA). The season was defined as "W" (winter; January-May).

Season	Area	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Mid-Coast (MA)	10	0.402	32.35	0.25	17	60
W	Offshore (MA)	1	0.027	1.88	0.32	1	6
W	Cape Cod South (MA)	1	0.023	16.65	1.00	1	93
W	Southern New England (MA)	22	0.055	110.86	0.23	66	180
W	Subtotal	34	-	161.74	0.19	107	245
	Total	34	-	161.74	0.19	107	245

Table 6. Observed number of bycatch, estimated bycatch rates per metric ton landed, estimated bycatch, coefficient of variation (CV), and lower (L) and upper (U) limits on 95% confidence intervals (CI) of harbor seal (*Phoca vitulina vitulina*) bycatch in the New England sink gillnet fishery for 2019 by season and portgroup (P) or management area (MA). Seasons were defined as "W" (winter; January-May), "S" (summer; June-August), and "F" (fall; September-December).

Season	Area	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Mid-Coast (MA)	8	0.313	25.42	0.23	14	43
W	Offshore (MA)	2	0.054	3.76	0.44	2	16
W	Cape Cod South (MA)	2	0.046	33.29	0.96	2	181
W	Southern New England (MA)	10	0.022	45.61	0.32	23	97
W	Subtotal	22	-	108.09	0.31	60	225
S	North of Boston (P)	1	0.034	9.05	0.78	1	36
S	New Hampshire (P)	1	0.008	4.55	0.75	1	26
S	Offshore (P)	5	0.214	45.33	0.37	12	87
S	Southern Maine (P)	6	0.119	31.76	0.33	15	65
S	Subtotal	13	-	90.69	0.24	51	146
F	East of Cape Cod (P)	2	0.012	20.72	0.95	2	124
F	Mid-Coast (MA)	16	0.203	62.50	0.22	36	106
F	North of Boston (P)	2	0.37	17.61	0.51	2	38
F	Southern Maine (P)	3	0.071	7.48	0.45	3	21
F	Southern New England (MA)	1	0.032	8.41	0.97	1	53
F	Subtotal	24	-	116.72	0.23	74	202
	Total	59	-	315.50	0.15	233	451

Table 7. Observed number of bycatch, estimated bycatch rates per metric ton landed, estimated bycatch, coefficient of variation (CV), and lower (L) and upper (U) limits on 95% confidence intervals (CI) of gray seal (*Halichoerus grypus atlantica*) bycatch in the New England sink gillnet fishery for 2019 by season and portgroup (P) or management area (MA). Seasons were defined as "W" (winter; January-May), "S" (summer; June-August), and "F" (fall; September-December).

Season	Area	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI	
						L	U
W	Mid-Coast (MA)	13	0.555	43.91	0.22	26	76
W	Offshore (MA)	13	0.407	26.28	0.26	15	62
W	Cape Cod South (MA)	25	0.574	416.08	0.24	256	649
W	Southern New England (MA)	108	0.266	535.39	0.15	393	754
W	Subtotal	159	-	1021.66	0.12	792	1316
S	East of Cape Cod (P)	13	0.056	178.24	0.3	93	306
S	North of Boston (P)	25	1.899	471.00	0.66	128	1663
S	New Hampshire (P)	4	0.034	18.20	0.44	7	50
S	Offshore (P)	7	0.299	63.46	0.55	14	195
S	Southern Maine (P)	9	0.175	46.72	0.33	20	91
S	South of Boston (P)	3	0.154	19.68	0.88	3	123
S	Subtotal	61	-	797.30	0.43	412	1870
F	East of Cape Cod (P)	5	0.031	51.80	0.48	15	131
F	Mid-Coast (MA)	17	0.215	66.42	0.23	40	126
F	North of Boston (P)	1	0.236	10.95	0.63	1	44
F	Southern Maine (P)	1	0.023	2.46	0.45	1	7
F	South of Boston (P)	1	0.156	7.48	0.94	1	30
F	Cape Cod South (MA)	6	0.248	56.22	0.46	15	123
F	Subtotal	31	-	195.32	0.20	131	313
	Total	251	-	2014.28	0.17	1511	2925

Table 8. Summary of 2019 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	Observed Hauls	Hauls with < 100% of Required Pingers	100% of Required Pingers
Fall	Cape Cod South	29	10	65.5%
	Massachusetts Bay	1	0	100.0%
	Mid-Coast	302	64	78.8%
	Offshore	2	0	100.0%
	Southern New England	29	13	55.2%
	Stellwagen Bank	31	0	100.0%
Winter	Cape Cod South	78	28	64.1%
	MidCoast	128	31	75.8%
	Offshore	105	44	58.1%
	Southern New England	416	217	47.8%
	Stellwagen Bank	83	1	98.8%
Total		1204	408	66.1%

Table 9. 2019 Mid-Atlantic gillnet fishery summaries of observed trips, commercial trips, observed landings, commercial landings, and observer coverage by state (Figure 2b). Effort from bays and sounds is not included. Commercial landings shown for Connecticut and Rhode Island stem from boats from those states fishing west of 72.5°W.

State	Observed Trips	Commercial Trips	Observed Landings (mt)	Commercial Landings (mt)	Observed Coverage (trips)	Observer Coverage (mt)
Connecticut	0	1	0.00	2.77	0.00%	0.00%
Maryland	30	225	34.56	405.03	13.33%	8.53%
New Jersey	228	1,446	392.64	2361.08	15.77%	16.63%
New York	36	198	61.23	198.15	18.18%	30.90%
North Carolina	233	3,811	178.53	2390.20	6.11%	7.47%
Rhode Island	0	7	0.00	148.42	0.00%	0.00%
Virginia	202	1,253	390.04	2732.14	16.12%	14.28%
Total	729	6,941	1057.00	8237.79	10.50%	12.83%

Table 10. Summaries of observed hauls, observed trips, observed landings, commercial landings, and observer coverage by species, season, region, mesh size, and soak duration for strata with bycatch of common dolphin (*Delphinus delphis delphis*), harbor porpoise (*Phocoena phocoena phocoena*), harp seal (*Pagophilus groenlandicus*), harbor seal (*Phoca vitulina vitulina*), or gray seal (*Halichoerus grypus atlantica*) in the 2019 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 (trip)	Observer Coverage (mt)
Common Dolphin	Dec-Mar	Waters off New Jersey	>= 7	> 72	31 (10)	10	20.51	185.22	11.36%	11.08%
Common Dolphin	Feb-Mar	Southern Mid-Atlantic	< 7	<= 72	975 (224)	175	264.28	1918.01	15.92%	13.78%
Harbor Porpoise	Jan-May	Waters off New Jersey	>= 7	<= 72	161 (14)	67	126.49	729.89	20.06%	17.33%
Harbor Porpoise	Jan-Apr	Southern Mid-Atlantic	< 7	<= 72	1620 (371)	292	427.06	3197.45	15.77%	13.36%
Harp Seal	Jan-Apr	Waters off New Jersey	>= 7	> 72	24 (10)	8	16.03	156.75	10.39%	10.22%
Harbor Seal	Jan-May	Waters off New Jersey	>= 7	> 72	50 (10)	22	47.20	245.82	20.37%	19.2%
Harbor Seal	Jan-May	Waters off New Jersey	>= 7	<= 72	161 (14)	67	126.49	729.89	20.06%	17.33%
Gray Seal	Jan-May	Waters off New Jersey	>= 7	> 72	50 (10)	22	47.20	245.82	20.37%	19.2%
Gray Seal	Jan-May	Waters off New Jersey	>= 7	<= 72	161 (14)	67	126.49	729.89	20.06%	17.33%
Gray Seal	Jan-Apr	Southern Mid-Atlantic	< 7	<= 72	1620 (371)	292	427.06	3197.45	15.77%	13.36%

[a] Parentheses indicate the number of limited hauls out of the total (i.e., complete + limited). During complete sampling, observers do not explicitly watch

Table 11. Observed number of bycatch, estimated bycatch rates per metric ton landed, estimated bycatch, coefficient of variation (CV), and lower and upper limits on 95% confidence intervals (CI) of estimated common dolphin (*Delphinus delphis delphis*), harbor porpoise (*Phocoena phocoena phocoena*), harp seal (*Pagophilus groenlandicus*), harbor seal (*Phoca vitulina vitulina*), or gray seal (*Halichoerus grypus atlantica*) bycatch in the Mid-Atlantic gillnet fishery for 2019, by season, region, mesh size, and soak duration. Total rows for each species estimate bycatch by merging the strata listed above them.

Species	Season	Region	Mesh Size (in)	Soak Duration (hrs)	Observed Bycatch	Bycatch Rate	Estimated Bycatch	CV	95% CI
common dolphin	Dec-Mar	Waters off New Jersey	>= 7	> 72	1	0.0159	5.0	0.66	1-25
common dolphin	Feb-Mar	Southern Mid-Atlantic	< 7	<= 72	2	0.0076	14.5	0.72	2-76
common dolphin					3	0.0087	19.5	0.56	3-82
harbor porpoise	Jan-May	Waters off New Jersey	>= 7	<= 72	1	0.0079	5.8	0.66	1-29
harbor porpoise	Jan-Apr	Southern Mid-Atlantic	< 7	<= 72	1	0.0023	7.5	0.72	1-35
harbor porpoise				<= 72	2	0.0033	13.3	0.51	2-48
harp seal	Jan-Apr	Waters off New Jersey	>= 7	> 72	3	0.1872	29.3	0.84	3-132
harbor seal	Jan-May	Waters off New Jersey	>= 7	> 72	1	0.0212	5.2	0.56	1-18
harbor seal	Jan-May	Waters off New Jersey	>= 7	<= 72	2	0.0158	11.5	0.44	2-33
harbor seal	Jan-May	Waters off New Jersey	>= 7		3	0.0171	16.7	0.35	7-41
gray seal	Jan-May	Waters off New Jersey	>= 7	> 72	1	0.0212	5.2	0.63	1-22
gray seal	Jan-May	Waters off New Jersey	>= 7	<= 72	1	0.0079	5.8	0.66	1-26
gray seal	Jan-Apr	Southern Mid-Atlantic	< 7	<= 72	1	0.0023	7.5	0.71	1-36
gray seal					3	0.0043	18.5	0.40	7-51

Table 12. Observed number of hauls for large (7-18") and small (5-7") mesh 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 and were not included in the count of non-compliant hauls. Locations are depicted in Figures 1 and 2b.

				General HPTRP Non-adherence Categories		Specific HPTRP Non-adherence Categories						
Management Area	Observed Hauls	Non-Compliant Hauls	Compliance %	Gear Modification	Closed Area	Multiple Violations per Haul	Number of Nets	Twine Size	Tie-Down Length	Tie-Down Use	Net Length	Missing Some Gear Information[a]
Mudhole North Large Mesh	8	3	62%	3	0	3	3	0	3	0	0	0
Mudhole North Small Mesh	13	7	46%	7	0	3	3	0	0	0	7	6
Mudhole South Large Mesh	3	3	0%	0	3	0	0	0	0	0	0	0
Southern Mid-Atlantic Large Mesh	12	7	42%	7	0	0	0	0	0	7	0	0
Southern Mid-Atlantic Small Mesh	257	93	64%	93	0	6	0	50	0	8	41	48
Waters off New Jersey Large Mesh	87	49	44%	49	0	5	40	0	7	7	0	9
Waters off New Jersey Small Mesh	52	12	77%	12	0	4	2	4	0	1	4	9
Totals	432	174	60%	171	3	21	48	54	10	23	52	72

[a] Hauls for which at least 1 gear component was not recorded and therefore could not be checked for compliance. There may be some hauls

Table 13. Observed summaries for the 5-year period of 2015-2019. (A) Observer coverage by fishery and year. (B, C) Observed and estimated serious injuries and mortalities of marine mammals in the (B) New England sink gillnet and (C) Mid-Atlantic gillnet fisheries. The "Combined Estimate" is Estimated Mortality + Estimated Serious Injury.

(A) Observer coverage as fraction of metric tons landed, by fishery and year.

Fishery	Years	Data Type	Observer Coverage (mt)
New England sink gillnet	2015-19	Obs. Data, Trip Logbook, Allocated Dealer Data	0.14, 0.10, 0.12, 0.11, 0.12
Mid-Atlantic gillnet	2015-19	Obs. Data, Trip Logbook, Allocated Dealer Data	0.06, 0.08, 0.09, 0.09, 0.13

(B) Observed and estimated serious injuries and mortalities of marine mammals in the New England sink gillnet fishery for 2015-2019. CV = coefficient of variation.

Species	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Combined Estimate	Estimated CV	Mean (CV) Annual Combined
harbor porpoise (*Phocoena phocoena phocoena*)	0, 0, 1, 0, 0	23, 11, 18, 9, 33	0, 0, 7, 0, 0	177, 125, 129, 92, 195	177, 125, 136, 92, 195	0.28, 0.34, 0.28, 0.52, 0.22	145 (0.14)
bottlenose dolphin (*Tursiops truncatus truncatus*)	0, 0, 0, 0, 0	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 8, 0, 0	0, 0, 8, 0, 0	0, 0, 0.92, 0, 0	2 (4.6)
common dolphin (*Delphinus delphis delphis*)	0, 0, 0, 0, 0	3, 8, 20, 10, 1	0, 0, 0, 0, 0	55, 80, 133, 93, 5	55, 80, 133, 93, 5	0.54, 0.38, 0.28, 0.45, 0.68	73 (0.19)
gray seal (*Halichoerus grypus atlantica*)	0, 0, 0, 0, 0	131, 43, 158, 103, 251	0, 0, 0, 0, 0	1021, 498, 930, 1113, 2019	1021, 498, 930, 1113, 2019	0.25, 0.33, 0.16, 0.32, 0.17	1116 (0.11)
harbor seal (*Phoca vitulina vitulina*)	0, 0, 0, 0, 0	87, 36, 63, 22, 59	0, 0, 0, 0, 0	474, 245, 298, 188, 316	474, 245, 298, 188, 316	0.17, 0.29, 0.18, 0.36, 0.15	304 (0.1)
Risso's dolphin (*Grampus griseus*)	0, 0, 0, 0, 0	0, 0, 0, 0, 1	0, 0, 0, 0, 0	0, 0, 0, 0, 5	0, 0, 0, 0, 5	0, 0, 0, 0, 0.7	1 (3.5)
harp seal (*Pagophilus groenlandicus*)	0, 0, 0, 0, 0	12, 5, 6, 2, 34	0, 0, 0, 0, 0	119, 85, 44, 14, 163	119, 85, 44, 14, 163	0.34, 0.5, 0.37, 0.8, 0.19	85 (0.16)

(C) Observed and estimated serious injuries and mortalities of marine mammals in the Mid-Atlantic gillnet fishery for 2015-2019. CV = coefficient of variation.

Species	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Combined Estimate	Estimated CV	Mean (CV) Annual Combined
harbor porpoise (*Phocoena phocoena phocoena*)	0, 0, 0, 0, 0	2, 2, 1, 0, 2	0, 0, 0, 0, 0	33, 23, 9, 0, 13	33, 23, 9, 0, 13	1.16, 0.64, 0.95, 0, 0.51	16 (0.68)
common dolphin (*Delphinus delphis delphis*)	0, 0, 1, 0, 0	3, 1, 1, 1, 3	0, 0, 11, 0, 0	30, 7, 11, 8, 20	30, 7, 22, 8, 20	0.55, 0.97, 0.71, 0.91, 0.56	17 (0.31)
gray seal (*Halichoerus grypus atlantica*)	0, 0, 0, 0, 0	1, 1, 0, 0, 3	0, 0, 0, 0, 0	15, 7, 0, 0, 18	15, 7, 0, 0, 18	1.04, 0.93, 0, 0, 0.4	8 (0.76)
harbor seal (*Phoca vitulina vitulina*)	0, 0, 0, 0, 0	5, 2, 1, 3, 3	0, 0, 0, 0, 0	48, 18, 3, 26, 17	48, 18, 3, 26, 17	0.52, 0.95, 0.62, 0.52, 0.35	22 (0.3)
harp seal (*Pagophilus groenlandicus*)	0, 0, 0, 0, 0	0, 0, 0, 0, 3	0, 0, 0, 0, 0	0, 0, 0, 0, 29	0, 0, 0, 0, 29	0, 0, 0, 0, 0.84	6 (4.2)
hooded seal (*Cystophora cristata*)	0, 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, 1.12, 0, 0, 0	1 (5.6)

FIGURES

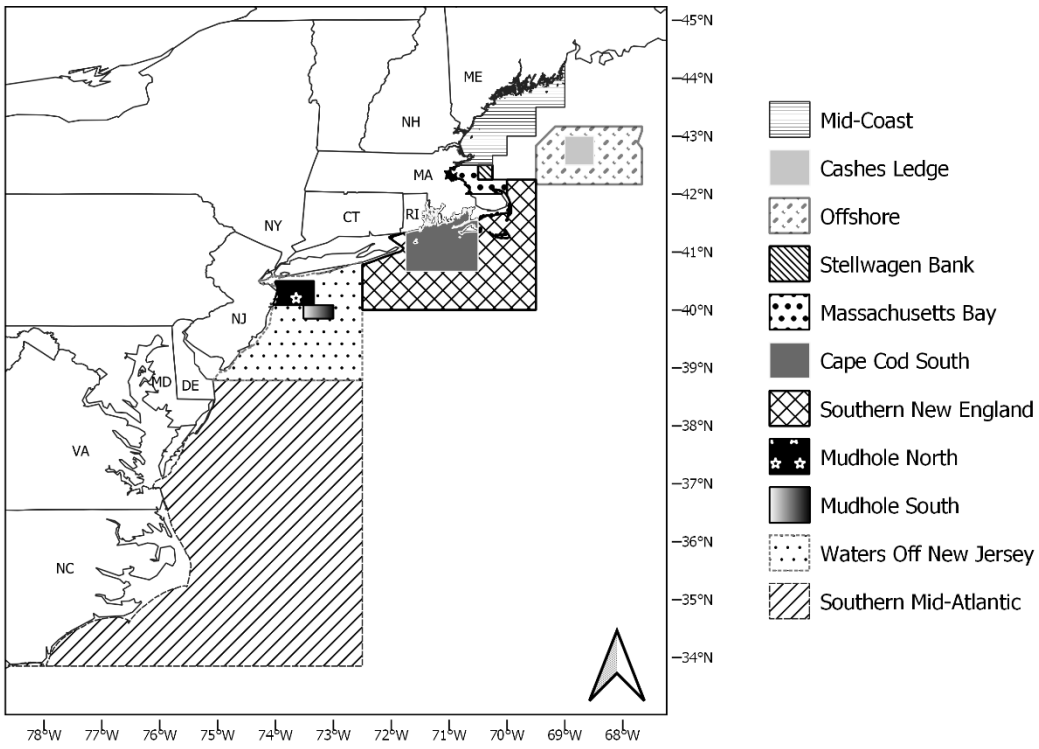

Figure 1. Management areas used in this report. Mudhole North and Mudhole South, where gear restrictions differ from the Waters Off New Jersey area, are referred to only in Table 12 on compliance with the requirements of the Mid-Atlantic 2010 Harbor Porpoise Take Reduction Plan. For the purposes of estimating bycatch in the Mid-Atlantic gillnet fishery, Mudhole North and Mudhole South are considered part of the Waters Off New Jersey management area. Portgroups are not shown; they reflect the port where the catch was landed. Portgroups are used for trips whose location was unknown, trips which fished outside the management areas, and trips which fished inside the management areas but outside the times when management measures were in place.

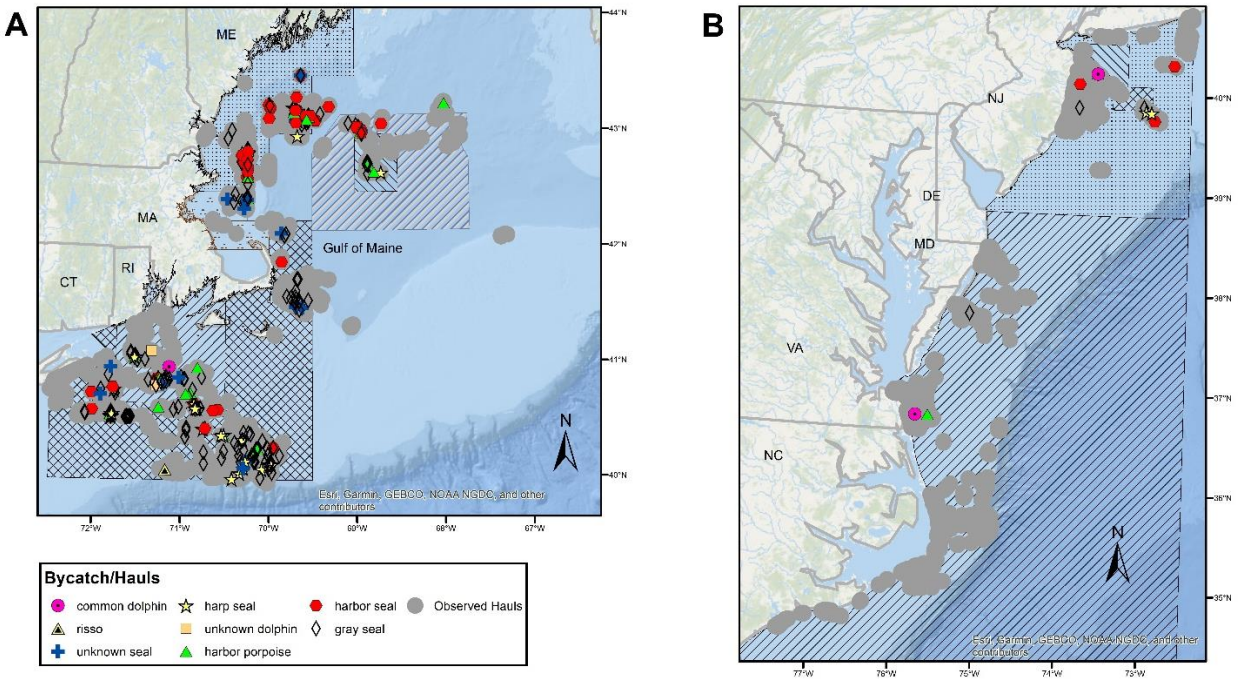

Figure 2. Locations of observed hauls and marine mammal bycatch in the 2019 New England sink gillnet (A) and Mid-Atlantic (B) gillnet fisheries. Observed bycatch consisted of harbor porpoise (*Phocoena phocoena phocoena*), common dolphin (*Delphinus delphis delphis*), Risso's dolphin (*Grampus griseus*), gray seal (*Halichoerus grypus atlantica*), harbor seal (*Phoca vitulina vitulina*), harp seal (*Pagophilus groenlandicus*), and unknown dolphin and seal species.

APPENDIX

The results of exploring Ecological Production Unit (EPU)-based stratification options for 2019 bycatch of gray seal, harbor seal, and harp seal are given in the tables below. The EPUs used in tables A1-A3 are Georges Bank, Gulf of Maine, the northern Mid-Atlantic Bight, and the southern Mid-Atlantic Bight. In tables A4-A6, Southern New England is used in addition to or instead of the EPUs used in tables A1-A3. Southern New England is defined as the polygon used in Smith & Smith (2020).

Table A1. 2019 gray seal (*Halichoerus grypus atlantica*) bycatch when stratified by EPU (Georges Bank [GB]; Gulf of Maine [GOM]; Mid-Atlantic Bight north of 38.7833°N [MABN]; Mid-Atlantic Bight south of 38.7833°N [MABS]), small or large mesh size (smaller than 7 inches; 7 inches or larger), and calendar quarter.

Stratum	Observed Landings (mt)	Commercial Landings (mt)	Observed Bycatch	Bycatch Rate (animals/mt landed)	Estimated Bycatch	95% CI (lower)	95% CI (upper)
GB_Lg_Q2	22	380	5	0.2311	87.9	22	176
GB_Lg_Q3	207	2,680	9	0.0435	116.6	56	225
GB_Lg_Q4	18	402	1	0.0554	22.3	1	91
GOM_Lg_Q1	7	26	3	0.4281	11.1	3	36
GOM_Lg_Q2	40	250	56	1.3829	345.7	213	694
GOM_Lg_Q3	156	1,014	14	0.0900	91.2	52	160
GOM_Lg_Q4	43	189	17	0.3934	74.2	47	130
GOM_Sm_Q1	47	91	2	0.0430	3.9	2	9
GOM_Sm_Q2	13	134	3	0.2376	31.9	4	91
GOM_Sm_Q4	74	167	1	0.0136	2.3	1	9
MABN_Lg_Q1	209	1,347	55	0.2637	355.3	227	606
MABN_Lg_Q2	478	3,892	81	0.1695	659.7	472	957
MABN_Lg_Q4	261	1,933	6	0.0230	44.4	18	120
MABS_Sm_Q1	397	1,460	1	0.0025	3.7	1	16
Total	**1,970**	**13,964**	**254**	**0.1331**	**1,850.1**	**1,506**	**2,287**

Table A2. 2019 harbor seal (*Phoca vitulina vitulina*) bycatch when stratified by EPU (Georges Bank [GB]; Gulf of Maine [GOM]; Mid-Atlantic Bight north of 38.7833°N [MABN]; Mid-Atlantic Bight south of 38.7833°N [MABS]), small or large mesh size (smaller than 7 inches; 7 inches or larger), and calendar quarter.

Stratum	Observed Landings (mt)	Commercial Landings (mt)	Observed Bycatch	Bycatch Rate (animals/mt landed)	Estimated Bycatch	95% CI (lower)	95% CI (upper)
GOM_Lg_Q1	7	26	2	0.2854	7.4	2	26
GOM_Lg_Q2	40	250	9	0.2223	55.6	30	98
GOM_Lg_Q3	156	1,014	14	0.0900	91.2	54	153
GOM_Lg_Q4	43	189	19	0.4396	83.0	50	126
GOM_Sm_Q2	13	134	1	0.0792	10.6	1	57
GOM_Sm_Q4	74	167	1	0.0136	2.3	1	8
MABN_Lg_Q1	209	1,347	13	0.0623	84.0	44	173
MABN_Lg_Q2	478	3,892	2	0.0042	16.3	2	51
MABN_Lg_Q4	261	1,933	1	0.0038	7.4	1	35
Total	**1,280**	**8,951**	**62**	**0.0386**	**357.7**	**275**	**471**

Table A3. 2019 harp seal (*Pagophilus groenlandicus*) bycatch when stratified by EPU (Georges Bank [GB]; Gulf of Maine [GOM]; Mid-Atlantic Bight north of 38.7833°N [MABN]; Mid-Atlantic Bight south of 38.7833°N [MABS]), small or large mesh size (smaller than 7 inches; 7 inches or larger), and calendar quarter.

Stratum	Observed Landings (mt)	Commercial Landings (mt)	Observed Bycatch	Bycatch Rate (animals/mt landed)	Estimated Bycatch	95% CI (lower)	95% CI (upper)
GOM_Lg_Q1	7	26	3	0.428	11	3	48
GOM_Lg_Q2	40	250	7	0.173	43	19	94
GOM_Sm_Q1	47	91	1	0.021	2	1	6
MABN_Lg_Q1	209	1,347	15	0.072	97	49	184
MABN_Lg_Q2	478	3,892	11	0.023	90	43	184
Total	**780**	**5,606**	**37**	**0.043**	**243**	**163**	**365**

Table A4. 2019 gray seal (*Halichoerus grypus atlantica*) bycatch when stratified by EPU (Georges Bank [GB]; Gulf of Maine [GOM]; Mid-Atlantic Bight north of 38.7833°N [MABN]; Mid-Atlantic Bight south of 38.7833°N [MABS]; Southern New England [SNE]), small or large mesh size (smaller than 7 inches; 7 inches or larger), and calendar quarter.

Stratum	Observed Landings (mt)	Commercial Landings (mt)	Observed Bycatch	Bycatch Rate (animals/mt landed)	Estimated Bycatch	95% CI (lower)	95% CI (upper)
GB_Lg_Q2	12	140	3	0.2599	36.5	3	69
GB_Lg_Q3	167	1,243	7	0.0419	52.0	25	106
GB_Lg_Q4	13	230	1	0.0750	17.2	1	63
GOM_Lg_Q1	7	26	3	0.4281	11.1	3	38
GOM_Lg_Q2	40	250	56	1.3829	345.7	213	698
GOM_Lg_Q3	156	1,014	14	0.0900	91.2	52	160
GOM_Lg_Q4	43	188	17	0.3934	74.0	46	129
GOM_Sm_Q1	47	91	2	0.0430	3.9	2	10
GOM_Sm_Q2	13	134	3	0.2376	31.9	3	90
GOM_Sm_Q4	74	167	1	0.0136	2.3	1	9
MABN_Lg_Q2	84	433	1	0.0119	5.2	1	24
MABS_Sm_Q1	397	1,460	1	0.0025	3.7	1	17
SNE_Lg_Q1	208	1,207	55	0.2650	319.8	203	546
SNE_Lg_Q2	404	3,698	82	0.2029	750.2	536	1,081
SNE_Lg_Q3	62	1,668	2	0.0322	53.8	2	191
SNE_Lg_Q4	217	1,736	6	0.0277	48.1	19	131
Total	**1,942**	**13,685**	**254**	**0.1356**	**1,846.5**	**1,504**	**2,298**

Table A5. 2019 harbor seal (*Phoca vitulina vitulina*) bycatch when stratified by EPU (Georges Bank [GB]; Gulf of Maine [GOM]; Mid-Atlantic Bight north of 38.7833°N [MABN]; Mid-Atlantic Bight south of 38.7833°N [MABS]; Southern New England [SNE]), small or large mesh size (smaller than 7 inches; 7 inches or larger), and calendar quarter.

Stratum	Observed Landings (mt)	Commercial Landings (mt)	Observed Bycatch	Bycatch Rate (animals/mt landed)	Estimated Bycatch	95% CI (lower)	95% CI (upper)
GOM_Lg_Q1	7	26	2	0.2854	7.4	2	27
GOM_Lg_Q2	40	250	9	0.2223	55.6	30	98

GOM_Lg_Q3	156	1,014	14	0.0900	91.2	54	153
GOM_Lg_Q4	43	188	19	0.4396	82.7	49	125
GOM_Sm_Q2	13	134	1	0.0792	10.6	1	58
GOM_Sm_Q4	74	167	1	0.0136	2.3	1	8
MABN_Lg_Q2	84	433	1	0.0119	5.2	1	20
SNE_Lg_Q1	208	1,207	13	0.0626	75.6	41	156
SNE_Lg_Q2	404	3,698	1	0.0025	9.1	1	49
SNE_Lg_Q4	217	1,736	1	0.0046	8.0	1	42
Total	**1,245**	**8,853**	**62**	**0.0376**	**347.7**	**269**	**454**

Table A6. 2019 harp seal (*Pagophilus groenlandicus*) bycatch when stratified by EPU (Georges Bank [GB]; Gulf of Maine [GOM]; Mid-Atlantic Bight north of 38.7833°N [MABN]; Mid-Atlantic Bight south of 38.7833°N [MABS]; Southern New England [SNE]), small or large mesh size (smaller than 7 inches; 7 inches or larger), and calendar quarter.

Stratum	Observed Landings (mt)	Commercial Landings (mt)	Observed Bycatch	Bycatch Rate (animals/mt landed)	Estimated Bycatch	95% CI (lower)	95% CI (upper)
GOM_Lg_Q1	7	26	3	0.428	11	3	51
GOM_Lg_Q2	40	250	7	0.173	43	19	94
GOM_Sm_Q1	47	91	1	0.021	2	1	6
SNE_Lg_Q1	208	1,207	15	0.072	87	45	166
SNE_Lg_Q2	404	3,698	11	0.027	101	48	211
Total	**706**	**5,272**	**37**	**0.045**	**244**	**160**	**369**

REFERENCE CITED IN APPENDIX

Smith BE and Smith LA. 2020. Multispecies functional responses reveal reduced predation at high prey densities and varied responses among and within trophic groups. Fish Fish 21(5):891-905.

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