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US DEPARTMENT OF COMMERCE
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Estimates of Seabird Bycatch in Commercial Fisheries off the East Coast of the United States from 2015 to 2016

Douglas B Sigourney[1], Christopher D Orphanides[2], and Joshua M Hatch[3]

[1]Integrated Statistics, 16 Sumner Street, Woods Hole, MA 02543
[2]Northeast Fisheries Science Center, 28 Tarzwell Drive Narragansett, RI 02882
[3]Northeast Fisheries Science Center, 166 Water Street, Woods, MA 02543-1026,

US DEPARTMENT OF COMMERCE
Wilbur Ross, Secretary
National Oceanic and Atmospheric Administration
Timothy Gallaudet, Under Secretary
National Marine Fisheries Service
Chris Oliver, Assistant Administrator for Fisheries
Northeast Fisheries Science Center
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ABSTRACT

This report provides bycatch estimates for 10 species of seabirds caught in commercial fisheries off the east coast of the United States during 2015 and 2016. A total of 655 birds were recorded as bycatch in commercial fishing gear, with 579 birds from the Northeast region and 76 birds in the Mid-Atlantic region. In 2015, total bycatch estimates among all gear types included 14 (CV = 1.02) Common Loons (*Gavia immer*), 49 (CV = 1.01) Double-crested Cormorants (*Phalacrocorax auritus*), 9 (CV = 0.91) Great Black-backed Gulls (*Larus marinus*), 1992 (CV = 0.06) Great Shearwaters (*Puffinus gravis*), 185 (CV = 0.52) Herring Gulls (*Larus smithsonianus*), 51 (CV = 0.28) Northern Fulmars (*Fulmarus glacialis*), 174 (CV = 0.41) Northern Gannets (*Morus bassanus*), 60 (CV = 0.92) Red-throated Loons (*Gavia stellata*), 16 (CV = 0.62) Sooty Shearwaters (*Puffinus griseus*), and 22 (CV = 0.51) Common Murres (*Uria aalge*). In 2016, total bycatch estimates among all gear types included 115 (CV = 0.42) Common Loons, 20 (CV = 0.65) Double-crested Cormorants, 26 (CV = 0.68) Great Black-backed Gulls, 1498 (CV = 0.10) Great Shearwaters, 121 (CV = 0.34) Herring Gulls, 9 (CV = 0.76) Northern Fulmars, 89 (CV = 0.38) Northern Gannets, 553 (CV = 0.19) Red-throated Loons, 81 (CV = 0.37) Sooty Shearwaters, and 16 (CV = 0.80) Common Murres.

INTRODUCTION

The interaction of marine birds with commercial fishing gear has been recognized as a serious conservation issue that threatens the long-term health of many populations worldwide (Croxall et al. 2012). A Memorandum of Understanding (MOU) between the US Department of Commerce National Marine Fisheries Service (NMFS) and US Department of Interior Fish and Wildlife Service (FWS) established a legal framework whereby interagency collaborations are recommended for conservation of migratory birds, in particular seabirds. Under the auspices of the MOU, NMFS is encouraged to conduct bycatch analyses of seabird species and coordinate with FWS to assess the population level effects.

To fulfill this requirement, Warden (2010) estimated interactions of Common and Red-throated Loons in the Northeast and Mid-Atlantic gillnet fisheries from 1996 to 2007. More recently, Hatch (2017) conducted a comprehensive analysis of bycatch for 10 species of seabirds across 6 gear types from 1996 to 2014.

The present study was built off the effort of Hatch (2017) to estimate seabird bycatch during 2015 and 2016. We estimated bycatch for 10 species of seabirds in 6 gear types in the Northeast and Mid-Atlantic United States (see Figure 1). A bycatch event was defined as any recorded interaction of a seabird with commercial fishing gear. We considered all interactions to be bycatch and did not distinguish between nonserious injury, serious injury, or mortality. We assessed bycatch for both fixed (i.e., gillnets, purse seines, and common beach seines) and mobile (i.e., bottom otter trawls, paired midwater trawls, and sea scallop dredges) gear types. For more information on the gear characteristics, target species, spatial/temporal distribution of fishing effort, management regulations, and overall observer coverage, refer to Appendix III in Hayes (2017).

METHODS

Fisheries Observer Data

To document the US Atlantic observed seabird bycatch and observer coverage for 2015 and 2016, we extracted data from the Northeast Fisheries Observer Program (NEFOP) and the At-sea Monitoring (ASM) program databases managed by the Northeast Fisheries Science Center. Both monitoring programs use trained people to collect data from commercial fishing vessels with a wide range of variables including kept and discarded catch, configuration of fishing gear, and protected species interactions (Fisheries Sampling Branch, 2016). The ASM monitors collect a reduced dataset in comparison to the NEFOP observers, where the ASM program is focused primarily on groundfish catch in the Northeast region.

Commercial Fishing Data

We obtained the total commercial fishing effort from mandatory vessel trip reports (VTRs), which the Greater Atlantic Regional Fisheries Office collected. Fishing effort was defined by the most appropriate gear-specific unit of fishing effort. For mobile gears (bottom otter trawls, paired midwater trawls, and sea scallop dredges), we defined fishing effort as the total number of days fished, which we calculated with the equation

$$Days\ Fished = \frac{(Average\ tow\ duration\ (hrs)\ x\ Gear\ Quantity\ x\ Number\ of\ hauls)}{24}$$

where gear quantity is defined as the number of nets towed per haul and number of hauls is defined as the number of hauls per trip. For fixed gear types (gillnets, purse seines, and common beach seines), we summarized effort by using total fishery landings following similar protocols as in Warden (2010) and Hatch (2017). The VTR data were assumed to be a near census of fishing activity in terms of days fished from all commercial fleets using federally permitted fishing vessels except those solely permitted to catch American lobster (*Homarus americanus*). However, since the self-reported landings on VTRs for fixed gear types are prone to be biased low (Murray 2009), we augmented information on total effort with information contained in other databases. For most areas, these data were from seafood dealer weigh-out slips contained in the Commercial Fisheries Database Biological Sample (CFDBS). For the state of North Carolina, federal data from the VTR and CFDBS program were incomplete, thus, we used data from the North Carolina Division of Marine Fisheries Trip Ticket Program in lieu of federal data. Further details in regards to calculating total effort for fixed gear can be found in Hatch (2017).

Data Imputation

We imputed variables with missing values necessary to estimate seabird–fishery interactions in a manner similar to that developed in Warden and Orphanides (2008). The majority of missing values were replaced with the median or modal value calculated over the portion of a fishing trip that used a particular gear type. For continuous variables, missing values were not imputed if the coefficient of variation (CV) for a particular stratum (e.g., same fishing trip) was ≥30%.

Analysis

To estimate seabird bycatch we adopted the same Bayesian hierarchical approach detailed in Hatch (2017). We analyzed a total of 20 species-gear combinations for which there was observed bycatch. Each species-gear combination was analyzed separately. Within a species-gear combination, data were stratified by year, statistical area, season, and Fishery Management Plan (FMP). In the few cases where the observed fishing effort for a stratum was greater than its measured total fishing effort, the observed bycatch was considered a complete census for that stratum and therefore was not estimated in the analysis (see Table 1). Statistical areas are shown in Figure 1, FMPs are listed in Table 2, and seasons were defined by calendar quarters.

For all strata where observers did not document any bycatch of seabirds, we assumed the total bycatch to be zero. For strata with observed bycatch, we fit a Bayesian model with the following hierarchical structure:

$$y_{ijs} \sim \mathrm{Poisson}(\lambda_{ijs} * e_{js})$$
$$\lambda_{ijs} \sim \mathrm{Gamma}(\alpha_{ij}, \beta_{ij})$$

$$\alpha_{ij} \sim \mathrm{Gamma}(\mathit{rate}_{ij}, \mathit{shape}_{ij})$$
$$\beta_{ij} \sim \mathrm{Gamma}(\mathit{rate}_{ij}, \mathit{shape}_{ij}) \text{ or } \beta_{ij} \sim \exp(\mathit{rate}_{ij})$$

where y_{ijs} is the observed number of bycaught animals of species *i* in gear *j* and stratum *s*, e_{js} is the observed fishing effort of gear *j* in stratum *s*, λ_{ijs} is the estimated bycatch rate for species *i* in gear *j* and stratum *s*, and α_{ij} and β_{ij} are hyperparameters specific to species *i* and gear *j* which are defined by the parameters rate_{ij} and shape_{ij}.

For the hyperparameters, we constructed informative prior distributions from a post-hoc analysis of the posterior distributions from Hatch (2017), who analyzed data collected in the years 1996 to 2014. Specifically, we fit separate gamma distributions to the posterior distributions of the α_{ij} and β_{ij} that were estimated in Hatch (2017) for each species-gear combination that was subsequently analyzed in this study. We then used the *rate* and *shape* parameters from each fit as an informed prior for the α_{ij} and β_{ij} in the analyses of the new data (2015 and 2016). For 2 species-gear combinations, an exponential distribution provided a better fit to the Hatch (2017) posteriors of β_{ij} and was therefore used in lieu of a gamma distribution.

We estimated the total bycatch for species *i* in gear *j* and stratum *s* (TB_{ijs}) by multiplying the estimate of the corresponding bycatch rate (λ_{ijs}) by the measured total fishing effort for gear *j* in stratum *s* (E_{js}):

$$TB_{ijs} = \lambda_{ijs} * E_{js}$$

For all parameters of interest, we sampled from the joint posterior distribution with Markov Chain Monte Carlo sampling algorithms implemented in the software packages R and Just Another Gibbs Sampler (JAGS). Model convergence was assessed by calculating Gelman-Rubin statistics and examining traceplots. Parameter estimates were summarized by computing the mean and standard deviations from their respective marginal distributions. We also summarized estimates of total bycatch within a region (Mid-Atlantic or Northeast) by year and species-gear combination. Annual and region specific estimates of bycatch were estimated by summing the appropriate strata-specific estimates and applying the delta method to calculate the variance of the summed totals.

RESULTS

There was a total of 3152 distinct strata with commercial fishing effort, and of these strata 1425 (45%) were observed. Strata without any observer coverage represented less than 6% of all commercial fishing effort, and it was assumed there was no seabird bycatch in the unobserved strata. Of the strata that had observer coverage, a total of 81 strata had observed bycatch of seabirds. For strata with observed bycatch, the median observer coverage was 13% and ranged from 1.2% to 100% (Table 1).

Fisheries observers and monitors documented a total of 655 bycatch events of seabirds in 2015 and 2016. Bycatch included 10 species across 4 gear types (Table 1). The majority of observed bycatch was of Great Shearwaters (514) followed by Red-throated Loons (36), Herring Gulls (24), Northern Fulmars (20), Northern Gannets (17), Sooty Shearwaters (14), Common Loons (10), Common Murres (8), Great Black-backed Gulls (7), and Double-crested Cormorants (5). The majority of seabird interactions occurred in gillnets (613) followed by sea scallop dredges (21), bottom otter trawls (16), and paired midwater trawls (5) (Table 1). Total estimates of seabird bycatch for each species-gear combination are found in Tables 3-12. Seasonal variation is depicted in Figure 2. Variation among FMPs was also evident, with the highest percentage of overall bycatch occurring in the dogfish (*Squalus acanthias*) fishery (Figure 3). Variation in total estimates of bycatch among gear types mirrored variation in observed bycatch with the exception of paired midwater trawls which were responsible for a slightly greater percentage of the total estimated bycatch than bottom otter trawls (Figure 4).

In 2015, estimates of total takes across all gear types were 13.51 (CV = 1.02) Common Loons, 48.71 (CV = 1.01) Double-crested Cormorants, 8.91 (CV = 0.91) Great Black-backed Gulls, 1992.45 (CV = 0.06) Great Shearwaters, 185.19 (CV = 0.52) Herring Gulls, 50.60 (CV = 0.28) Northern Fulmars, 174.26 (CV = 0.41) Northern Gannets, 59.77 (CV = 0.92) Red-throated Loons, 16.22 (CV = 0.62) Sooty Shearwaters, and 22.28 (CV = 0.51) Common Murres.

In 2016, estimates of total takes across all gear types were 114.50 (CV = 0.42) Common Loons, 20.33 (CV = 0.65) Double-crested Cormorants, 26.34 (CV = 0.68) Great Black-backed Gulls, 1497.81 (CV = 0.10) Great Shearwaters, 121.34 (CV = 0.34) Herring Gulls, 8.51 (CV = 0.76) Northern Fulmars, 89.19 (CV = 0.38) Northern Gannets, 553.44 (CV = 0.19) Red-throated Loons, 80.93 (CV = 0.37) Sooty Shearwaters, and 15.78 (CV = 0.80) Common Murres.

Regional variation in bycatch was also evident depending on the species (see Tables 3-12). Bycatch of Northern Fulmars, Sooty Shearwaters, and Common Murres only occurred in the Northeast region, whereas bycatch of Double-crested Cormorants and Red-throated Loons only occurred in the Mid-Atlantic region. In addition, the majority of bycatch of Great Shearwaters (>99%) occurred in the Northeast region, whereas the majority of bycatch of Common Loons (>99%) occurred in the Mid-Atlantic region. For all other species, bycatch did not differ greatly among regions.

DISCUSSION

During 2015 and 2016 fisheries observers and monitors documented a total of 10 seabird species as bycatch in 4 gear types. The bycatch patterns observed in these years were similar to the dominant patterns observed in previous years as reported by Hatch (2017). More species and a greater number of birds were observed in the Northeast region than in the Mid-Atlantic region, but most species were observed as bycatch in both regions. Gillnets had the highest bycatch followed by sea scallop dredge, bottom otter trawls, and paired midwater trawls. In the Northeast, Great Shearwaters dominated the bycatch and were most likely to be observed in gillnets. In the Mid-Atlantic both Common Loons and Red-throated Loons were the most prevalent and were also most likely to be captured in gillnets.

Approximately 94% of all seabird bycatch occurred in gillnet fisheries. In particular, the dogfish fishery accounted for the highest overall proportion of bycatch mostly from high bycatch of Great Shearwaters. This finding aligned with Hatch (2017) who reported that 84% of all seabird bycatch occurred in gillnets in 1996 - 2014. A number of previous studies have also identified gillnets as the most common western Atlantic gear type involved in seabird interactions (Benjamins et al. 2008; Ellis et al. 2013; Forsell 1999). Further research and mitigation efforts should focus on the characteristics of gillnet fisheries that influence susceptibility of seabirds to bycatch.

Bycatch of great shearwaters dominated overall bycatch in the Northeast region in both 2015 and 2016. The most common location was off Cape Cod in and adjacent to Statistical Area 521 (see Figure 1). Hatch (2017) also found that Great Shearwaters have dominated bycatch in most years since 1996. This can be explained, in part, by Hatch et al. (2016) who demonstrated that Great Shearwater habitat usage greatly overlaps with the areas of highest fishing activity for gillnets. At present, we are not aware of any studies that have attempted to quantify the effect of bycatch on the population dynamics of Great Shearwaters. This species is currently listed under the 2008 Birds of Conservation Concern (USFWS 2008), prompting the need for further investigation into the impact of seabird bycatch on the long-term sustainability of the great shearwater population.

Loons tended to dominate bycatch in the Mid-Atlantic region. Warden (2010) demonstrated that bycatch of loons in gillnets tended to correlate with depth and sea surface temperature. The locations of observed bycatch for both Common and Red-throated Loons in 2015 and 2016 as shown in this study (Figure 1) were similar to that in previous years as reported by Warden (2010). In addition to location, Warden (2010) investigated how bycatch may impact population levels by calculating a potential biological removal (PBR) value. The PBR concept, originally developed for management of human-induced removals of marine mammals, was defined as the maximum number of animals that could be removed annually from a marine mammal stock by humans while allowing that stock to reach or maintain its optimal sustainable population level (Wade 1998). The concept of PBR is generally associated with marine mammal populations, but a number of studies have applied the measure to seabird populations by using a modified equation (Niel and Lebreton 2005; Dillingham and Fletcher 2008; Žydelis et al. 2009). Warden (2010) reported that overall Red-throated Loon bycatch estimates approached 60% of PBR.

Temporal variability was highly seasonal and species dependent. Bycatch seasonal patterns for each species were largely consistent with patterns reported in Hatch (2017). These patterns are assumed to be most likely driven by the breeding and migratory patterns of the different species (Nisbet et al. 2013; Hatch 2017). Annual fluctuations between 2015 and 2016 in bycatch were minor for most species with the exception of Red-throated Loons. Increases in observed bycatch of Red-throated Loons were evident across several strata (see Table 1), and therefore, this annual difference is not solely the result of one large bycatch event. Reasons for these annual fluctuations in loon bycatch could potentially be due to changes in loon foraging patterns, fishing locations, fishing techniques, or quality of the gears used.

This analysis adopted a Bayesian hierarchical approach. One advantage of the Bayesian approach is that estimates from previous analyses can continue to be updated with new data through use of the prior data (Gelman 2007). Because a rigorous analysis of seabird bycatch from 1996 to 2014 had already been conducted by Hatch (2017), new estimates of seabird bycatch were easily updated with more recent data by using the same model structure as Hatch (2017) and informative priors; this approach obviates the need to reanalyze the entire time series with the new data. Overall, the use of informed priors along with the hierarchical model structure reduced the uncertainty especially for the most data poor strata but did not greatly influence the final estimates as this is still a data-driven model (CVs decreased by approximately 10%, and the final total bycatch estimates only differed by less than 5% on average). In addition, we opted to use posterior medians in lieu of posterior means to calculate strata-specific estimates of bycatch from the marginal posterior distributions.

To summarize yearly and region specific totals, we summed the median strata-specific estimates. These derived totals could also be estimated directly in the Bayesian framework; however, the skewness of the posterior distributions results in a discrepancy between the sum of the posterior median estimates and the Bayesian estimates of the summed totals. We compared the 2 approaches and found the difference in estimates was less than 5% and both estimates fell well within the modal range of the posterior distributions. Regardless of how the yearly and region-specific totals are calculated, the uncertainty around the majority of the estimates was relatively high, and all estimates should be interpreted with caution. This high level of uncertainty is common for rare events, such as seabird bycatch. Continued modification of statistical analyses should be considered in future assessments to investigate the appropriate stratification and methods to produce accurate and robust estimates of bycatch.

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Table 1. Observed number of individual seabirds bycaught, amount of observed fishing effort, total fishing effort and consequential percent coverage (% Cov), by strata for each species and gear combination. Only strata with observed bycatch are presented. Gear abbreviations are: GN = gillnet, BOT = bottom trawl, SSD = sea scallop dredge, PMT = paired midwater trawl. Seasons are defined by calendar quarter (Winter = January-March, Spring = April-June, Summer = July-September, and Fall = October-December). Fisheries management plan (FMP) abbreviations are in Table 2. Statistical areas (Area) are shown in Figure 1. Effort is measured by metric tons of fish landed for fixed gear types and days fished for mobile gear types.

Species	Gear	Year	Season	FMP	Area	Observed Bycatch	Observed Effort	Total Effort	% Coverage
Common Loon (*Gavia immer*)	GN	2015	Winter	Dgx	537	1	7.0	11.9	58.3
	GN	2015	Winter	Dgx	625	1	22.1	266.1	8.3
	GN	2016	Spring	Dgx	621	4	16.8	198.5	8.5
	GN	2016	Spring	Shd	635	1	0.6	14.3	4.5
	GN	2016	Spring	Smk	635	1	6.2	152.2	4.1
	GN	2016	Winter	Dgx	625	1	28.7	353.0	8.1
	GN	2016	Winter	Mnk	615	1	12.2	168.6	7.2
	All	**All**	**All**	**All**	**All**	**10**	**93.6**	**1164.6**	**8.0**
Double-crested Cormorant (*Phalacrocorax auritus*)	GN	2015	Spring	Dgx	635	1	49.4	388.2	12.7
	GN	2015	Winter	Oth	635	1	3.8	166.0	2.3
	GN	2016	Fall	Cro	625	1	1.2	6.7	17.2
	GN	2016	Fall	Spt	625	2	3.4	26.5	13.0
	All	**All**	**All**	**All**	**All**	**5**	**57.8**	**587.4**	**9.8**
Great Black-backed Gull (*Larus marinus*)	BOT	2015	Spring	Ska	537	1	11.8	32.9	35.8
	BOT	2015	Winter	Msp	514	1	24.4	168.7	14.5
	BOT	2016	Fall	Msp	512	1	14.4	111.1	13.0
	GN	2015	Fall	Mnk	537	1	17.6	14.9	100*
	GN	2016	Fall	Msp	513	1	8.9	63.3	14.0
	GN	2016	Winter	Msp	514	1	9.5	42.0	22.7
	SSD	2016	Winter	Sca	622	1	41.3	510.0	8.1
	All	**All**	**All**	**All**	**All**	**7**	**127.9**	**942.9**	**13.6**
Great Shearwater (*Puffinus gravis*)	BOT	2015	Fall	Fsb	612	1	12.0	91.4	13.1
	BOT	2016	Fall	Msp	521	1	36.0	273.6	13.2
	BOT	2016	Summer	Mnk	521	1	6.8	10.0	68.6
	GN	2015	Fall	Dgx	521	39	24.1	218.9	11.0
	GN	2015	Fall	Mnk	513	1	22.3	42.7	52.3
	GN	2015	Fall	Mnk	514	2	35.9	137.4	26.1
	GN	2015	Fall	Msp	514	1	5.6	26.4	21.3
	GN	2015	Fall	Msp	515	69	42.1	194.6	21.7
	GN	2015	Fall	Msp	521	21	22.2	86.8	25.5
	GN	2015	Fall	Msp	522	3	7.0	31.5	22.2
	GN	2015	Fall	Ska	521	8	176.1	774.4	22.7
	GN	2015	Summer	Dgx	513	1	82.2	387.3	21.2
	GN	2015	Summer	Dgx	514	1	48.0	323.8	14.8
	GN	2015	Summer	Dgx	521	22	49.7	734.4	6.8
	GN	2015	Summer	Mnk	521	9	0.7	8.3	8.7
	GN	2015	Summer	Msp	515	14	38.4	146.8	26.2
	GN	2015	Summer	Msp	521	2	14.8	60.5	24.5
	GN	2015	Summer	Msp	522	11	7.6	26.9	28.2
	GN	2015	Summer	Ska	521	149	531.4	1993.0	26.7
	GN	2015	Summer	Ska	537	2	46.0	797.6	5.8
	GN	2015	Winter	Mnk	612	1	15.1	96.4	15.7
	GN	2015	Winter	Msp	514	27	54.3	97.8	55.6
	GN	2016	Fall	Dgx	521	2	70.9	839.0	8.4
	GN	2016	Fall	Msp	515	2	34.1	121.8	28.0
	GN	2016	Fall	Ska	521	42	167.1	1276.2	13.1
	GN	2016	Summer	Dgx	521	28	76.8	1389.0	5.5
	GN	2016	Summer	Msp	515	7	31.8	115.8	27.4
	GN	2016	Summer	Ska	521	43	170.0	2420.7	7.0
	GN	2016	Summer	Ska	539	2	22.9	2.7	100*
	SSD	2015	Fall	Sca	521	1	24.3	309.0	7.9
	SSD	2015	Summer	Sca	525	1	76.8	1326.8	5.8
	All	**All**	**All**	**All**	**All**	**514**	**1953**	**14361.5**	**13.6**

Herring Gull (*Larus smithsonianus*)	BOT	2015	Fall	Msp	521	1	112.0	606.3	18.5
	BOT	2015	Fall	Smb	611	1	4.5	89.0	5.0
	BOT	2015	Winter	Sms	525	1	2.4	19.1	12.7
	BOT	2016	Fall	Msp	515	1	22.7	194.0	11.7
	GN	2015	Fall	Msp	515	1	42.1	194.6	21.7
	GN	2015	Summer	Dgx	521	1	49.7	734.4	6.8
	GN	2016	Summer	Ska	521	1	170.0	2420.7	7.0
	SSD	2015	Fall	Sca	613	1	4.7	384.6	1.2
	SSD	2015	Spring	Sca	521	1	44.2	751.3	5.9
	SSD	2015	Spring	Sca	526	1	85.9	449.9	19.1
	SSD	2015	Spring	Sca	613	1	97.4	1082.1	9.0
	SSD	2015	Spring	Sca	615	4	43.6	503.8	8.6
	SSD	2016	Spring	Sca	521	2	69.7	845.0	8.2
	SSD	2016	Spring	Sca	621	3	12.2	155.5	7.8
	SSD	2016	Spring	Sca	622	1	146.5	1628.1	9.0
	SSD	2016	Winter	Sca	622	3	41.3	510.0	8.1
	All	**All**	**All**	**All**	**All**	**24**	**948.9**	**10568.4**	**9.0**
Northern Fulmar (*Fulmarus glacialis*)	GN	2015	Winter	Msp	514	7	54.3	97.8	55.6
	GN	2015	Winter	Msp	515	9	27.4	101.2	27.0
	GN	2015	Winter	Ska	537	1	152.5	1017.1	15.0
	GN	2016	Fall	Msp	515	1	34.1	121.8	28.0
	GN	2016	Winter	Dgx	514	1	10.4	20.9	49.6
	GN	2016	Winter	Msp	514	1	9.5	42.0	22.7
	All	**All**	**All**	**All**	**All**	**20**	**288.2**	**1400.8**	**20.6**
Northern gannet (*Morus bassanus*)	BOT	2016	Spring	Smb	622	3	10.4	135.9	7.6
	BOT	2016	Winter	Msp	522	2	44.3	285.1	15.6
	GN	2015	Spring	Dgx	635	1	49.4	388.2	12.7
	GN	2015	Spring	Msp	515	1	51.5	167.3	30.8
	GN	2015	Winter	Dgx	635	1	74.7	1325.4	5.6
	GN	2016	Winter	Cro	636	3	17.5	190.0	9.2
	PMT	2015	Winter	Her	521	5	0.3	8.8	3.2
	SSD	2016	Spring	Sca	616	1	26.2	267.1	9.8
	All	**All**	**All**	**All**	**All**	**17**	**274.3**	**2767.8**	**9.9**
Red-throated Loon (*Gavia stellata*)	GN	2015	Spring	Men	635	1	1.5	74.0	2.1
	GN	2015	Winter	Dgx	625	1	22.1	266.1	8.3
	GN	2016	Spring	Dgx	621	10	16.8	198.5	8.5
	GN	2016	Spring	Dgx	625	1	16.1	185.7	8.6
	GN	2016	Spring	Sbt	621	1	3.7	11.3	32.5
	GN	2016	Winter	Dgx	625	2	28.7	353.0	8.1
	GN	2016	Winter	Dgx	631	3	60.7	518.5	11.7
	GN	2016	Winter	Dgx	635	3	133.3	1861.0	7.2
	GN	2016	Winter	Shd	635	14	1.0	25.0	4.0
	All	**All**	**All**	**All**	**All**	**36**	**283.9**	**3493.1**	**8.1**
Sooty Shearwater (*Puffinus griseus*)	BOT	2016	Fall	Msp	521	1	36.0	273.6	13.2
	GN	2015	Fall	Msp	522	1	7.0	31.5	22.2
	GN	2015	Spring	Msp	513	1	8.9	56.6	15.8
	GN	2015	Summer	Ska	521	2	531.4	1993.0	26.7
	GN	2016	Fall	Dgx	521	1	70.9	839.0	8.4
	GN	2016	Fall	Ska	521	7	167.1	1276.2	13.1
	GN	2016	Summer	Ska	521	1	170.0	2420.7	7.0
	All	**All**	**All**	**All**	**All**	**14**	**991.3**	**6890.6**	**14.4**
Common Murre (*Uria aalge*)	GN	2015	Winter	Dgx	514	2	12.8	44.1	29.1
	GN	2015	Winter	Msp	514	2	54.3	97.8	55.6
	GN	2015	Winter	Ska	537	2	152.5	1017.1	15.0
	GN	2016	Winter	Ska	537	2	119.2	1008.6	11.8
	All	**All**	**All**	**All**	**All**	**8**	**338.8**	**2167.6**	**15.6**

Species	Gear	Year	Season	FMP	Area	Observed Bycatch	Observed Effort	Total Effort	% Coverage
Common Loon (*Gavia immer*)	GN	2015	Winter	Dgx	537	1	7.0	11.9	58.3
	GN	2015	Winter	Dgx	625	1	22.1	266.1	8.3
	GN	2016	Spring	Dgx	621	4	16.8	198.5	8.5
	GN	2016	Spring	Shd	635	1	0.6	14.3	4.5
	GN	2016	Spring	Smk	635	1	6.2	152.2	4.1
	GN	2016	Winter	Dgx	625	1	28.7	353.0	8.1
	GN	2016	Winter	Mnk	615	1	12.2	168.6	7.2
	All	**All**	**All**	**All**	**All**	**10**	**93.6**	**1164.6**	**8.0**
Double-crested Cormorant (*Phalacrocorax auritus*)	GN	2015	Spring	Dgx	635	1	49.4	388.2	12.7
	GN	2015	Winter	Oth	635	1	3.8	166.0	2.3
	GN	2016	Fall	Cro	625	1	1.2	6.7	17.2
	GN	2016	Fall	Spt	625	2	3.4	26.5	13.0
	All	**All**	**All**	**All**	**All**	**5**	**57.8**	**587.4**	**9.8**
Great Black-backed Gull (*Larus marinus*)	BOT	2015	Spring	Ska	537	1	11.8	32.9	35.8
	BOT	2015	Winter	Msp	514	1	24.4	168.7	14.5
	BOT	2016	Fall	Msp	512	1	14.4	111.1	13.0
	GN	2015	Fall	Mnk	537	1	17.6	14.9	100*
	GN	2016	Fall	Msp	513	1	8.9	63.3	14.0
	GN	2016	Winter	Msp	514	1	9.5	42.0	22.7
	SSD	2016	Winter	Sca	622	1	41.3	510.0	8.1
	All	**All**	**All**	**All**	**All**	**7**	**127.9**	**942.9**	**13.6**

*Observer effort is greater than total effort so coverage was assumed to be 100%.

Table 2. Definitions and abbreviations for Fishery Management Plans (FMP).

FMP	Description
Cro	Atlantic croaker (*Micropogonias undulatus*)
Dgx	Spiny dogfish (*Squalus acanthias*)
Fsb	Summer flounder, scup, and black sea bass
	Summer flounder (*Paralichthys dentatus*)
	Scup (*Stenotomus chrysops*)
	Black sea bass (*Centropristis striata*)
Her	Atlantic herring (*Clupea harengus*)
Men	Atlantic menhaden (*Brevoortia tyrannus*)
Mnk	Monkfish (*Lophius americanus*)
Msp	Northeast multispecies (groundfish)
	Atlantic cod (*Gadus morhua*)
	Haddock (*Melanogrammus aeglefinus*)
	Yellowtail flounder (*Limanda ferrugineus*)
	Atlantic pollock (*Pollachius virens*)
	American plaice (*Hippoglossoides platessoides*)
	Witch flounder (*Glyptocephalus cynoglossus*)
	White hake (*Urophycis tenuis*)
	Windowpane flounder (*Scophthalmus aquosus*)
	Atlantic halibut (*Hippoglossus hippoglossus*)
	Winter flounder (*Pseudopleuronectes americanus*)
	Acadian Redfish (*Sebastes fasciatus*)
	Atlantic wolffish (*Anarhichas lupus*)
	Ocean pout (*Zoarces americanus*)
Oth	Other
Sbt	Sharks, billfish, swordfish, and tuna
Sca	Atlantic sea scallops (*Placopecten magellanicus*)
Shd	American Shad (*Alosa sapidissima*) and river herring
	Alewife (*Alosa pseudoharengus*)
	Blueback herring (*Alosa aestivalis*)
Ska	Northeast skate complex
	Winter skate (*Leucoraja ocellata*)
	Barndoor skate (*Dipturus laevis*)
	Thorny skate (*Amblyraja radiata*)
	Smooth skate (*Malacoraja senta*)
	Little skate (*Leucoraja erinacea*)
	Clearnose skate (*Raja eglanteria*)
	Rosette skate (*Leucoraja garmani*)
Smb	Squid mackerel and butterfish
	Squid (*Doryteuthis pealeii*, *Illex illecebrosus*)
	Atlantic mackerel (*Scomber scrombus*)
	Butterfish (*Peprilus triacanthus*)
Smk	Spanish mackerel (*Scomberomorus maculatus*)
Sms	Small mesh multispecies
	Silver hake (*Merluccius bilinearis*)
	Red hake (*Urophycis chuss*)
	Offshore hake (*Merluccius albidus*)
Spt	Spot (*Leiostomus xanthurus*)

Table 3. Common Loon (*Gavia immer*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch Rate	Estimate	CV
2015	MA	Gillnet	Winter	Dgx	0.04	11.84	1.15
2015	**MA**	**Gillnet**	**All**	**All**		**11.84**	**1.15**
2015	**MA**	**All**	**All**	**All**		**11.84**	**1.15**
2015	NE	Gillnet	Winter	Dgx	0.14	1.67	1.15
2015	**NE**	**Gillnet**	**All**	**All**		**1.67**	**1.15**
2015	**NE**	**All**	**All**	**All**		**1.67**	**1.15**
2015	**All**	**All**	**All**	**All**		**13.51**	**1.02**
2016	MA	Gillnet	Spring	Dgx	0.24	46.70	0.52
2016	MA	Gillnet	Spring	Shd	1.28	18.29	1.15
2016	MA	Gillnet	Spring	Smk	0.16	23.73	1.19
2016	MA	Gillnet	Winter	Dgx	0.03	12.10	1.16
2016	MA	Gillnet	Winter	Mnk	0.08	13.67	1.16
2016	**MA**	**Gillnet**	**All**	**All**		**114.50**	**0.42**
2016	**MA**	**All**	**All**	**All**		**114.50**	**0.42**
2016	**All**	**All**	**All**	**All**		**114.50**	**0.42**

Table 4. Double-crested Cormorant (*Phalacrocorax auritus*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch rate	Estimate	CV
2015	MA	Gillnet	Spring	Dgx	0.02	7.54	1.18
2015	MA	Gillnet	Winter	Oth	0.25	41.17	1.18
2015	**MA**	**Gillnet**	**All**	**All**		**48.71**	**1.01**
2015	**MA**	**All**	**All**	**All**		**48.71**	**1.01**
2015	**All**	**All**	**All**	**All**		**48.71**	**1.01**
2016	MA	Gillnet	Fall	Cro	0.81	5.47	1.17
2016	MA	Gillnet	Fall	Spt	0.56	14.86	0.78
2016	**MA**	**Gillnet**	**All**	**All**		**20.33**	**0.65**
2016	**MA**	**All**	**All**	**All**		**20.33**	**0.65**
2016	**All**	**All**	**All**	**All**		**20.33**	**0.65**

Table 5. Great Black-backed Gull (*Larus marinus*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch rate	Estimate	CV
2015	NE	Bottom Otter Trawl	Spring	Ska	0.07	2.35	1.29
2015	NE	Bottom Otter Trawl	Winter	Msp	0.03	5.86	1.27
2015	**NE**	**Bottom Otter Trawl**	**All**	**All**		**8.21**	**0.98**
2015	NE	Gillnet	Fall	Mnk	0.05	0.70	1.29
2015	**NE**	**Gillnet**	**All**	**All**		**0.70**	**1.29**
2015	**NE**	**All**	**All**	**All**		**8.91**	**0.91**
2015	**All**	**All**	**All**	**All**		**8.91**	**0.91**
2016	MA	Sea Scallop Dredge	Winter	Sca	0.02	10.29	1.28
2016	**MA**	**Sea Scallop Dredge**	**All**	**All**		**10.29**	**1.28**
2016	**MA**	**All**	**All**	**All**		**10.29**	**1.28**
2016	NE	Bottom Otter Trawl	Fall	Msp	0.06	6.57	1.27
2016	**NE**	**Bottom Otter Trawl**	**All**	**All**		**6.57**	**1.27**
2016	NE	Gillnet	Fall	Msp	0.09	5.84	1.30
2016	NE	Gillnet	Winter	Msp	0.09	3.65	1.28
2016	**NE**	**Gillnet**	**All**	**All**		**9.48**	**0.94**
2016	**NE**	**All**	**All**	**All**		**16.06**	**0.76**
2016	**All**	**All**	**All**	**All**		**26.34**	**0.68**

Table 6. Great Shearwater (*Puffinus gravis*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch rate	Estimate	CV
2015	NE	Gillnet	Summer	Dgx	0.16	334.15	0.21
2015	NE	Gillnet	Summer	Mnk	8.51	70.94	0.34
2015	NE	Gillnet	Summer	Msp	0.63	98.19	0.20
2015	NE	Gillnet	Summer	Ska	0.16	593.38	0.09
2015	NE	Gillnet	Fall	Dgx	1.60	350.30	0.16
2015	NE	Gillnet	Fall	Mnk	0.05	9.58	0.65
2015	NE	Gillnet	Fall	Msp	0.78	414.52	0.10
2015	NE	Gillnet	Fall	Ska	0.05	35.25	0.36
2015	NE	Gillnet	Winter	Msp	0.49	48.35	0.19
2015	**NE**	**Gillnet**	**All**	**All**		**1954.66**	**0.06**
2015	NE	Sea Scallop Dredge	Summer	Sca	0.01	14.40	1.27
2015	NE	Sea Scallop Dredge	Fall	Sca	0.03	10.53	1.28
2015	**NE**	**Sea Scallop Dredge**	**All**	**All**		**24.93**	**0.91**
2015	**NE**	**All**	**All**	**All**		**1979.59**	**0.06**
2015	MA	Bottom Otter Trawl	Fall	Fsb	0.07	6.52	1.26
2015	**MA**	**Bottom Otter Trawl**	**All**	**All**		**6.52**	**1.26**
2015	MA	Gillnet	Winter	Mnk	0.07	6.33	1.14
2015	**MA**	**Gillnet**	**All**	**All**		**6.33**	**1.14**
2015	**MA**	**All**	**All**	**All**		**12.86**	**0.85**
2015	**All**	**All**	**All**	**All**		**1992.45**	**0.06**
2016	NE	Bottom Otter Trawl	Summer	Mnk	0.12	1.24	1.26
2016	NE	Bottom Otter Trawl	Fall	Msp	0.02	6.59	1.26
2016	**NE**	**Bottom Otter Trawl**	**All**	**All**		**7.84**	**1.08**
2016	NE	Gillnet	Summer	Dgx	0.36	503.34	0.19
2016	NE	Gillnet	Summer	Msp	0.22	25.24	0.39
2016	NE	Gillnet	Summer	Ska	0.17	610.30	0.15
2016	NE	Gillnet	Fall	Dgx	0.03	23.68	0.76
2016	NE	Gillnet	Fall	Msp	0.06	7.15	0.76
2016	NE	Gillnet	Fall	Ska	0.25	320.25	0.15
2016	**NE**	**Gillnet**	**All**	**All**		**1489.97**	**0.10**
2016	**NE**	**All**	**All**	**All**		**1497.81**	**0.10**
2016	**All**	**All**	**All**	**All**		**1497.81**	**0.10**

Table 7. Herring Gull (*Larus smithsonianus*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch rate	Estimate	CV
2015	NE	Bottom Otter Trawl	Fall	Msp	0.01	4.67	1.26
2015	NE	Bottom Otter Trawl	Winter	Sms	0.35	6.67	1.27
2015	**NE**	**Bottom Otter Trawl**	**All**	**All**		**11.34**	**0.91**
2015	NE	Gillnet	Summer	Dgx	0.02	12.26	1.28
2015	NE	Gillnet	Fall	Msp	0.02	3.81	1.30
2015	**NE**	**Gillnet**	**All**	**All**		**16.07**	**1.02**
2015	NE	Sea Scallop Dredge	Spring	Sca	0.01	18.72	1.01
2015	**NE**	**Sea Scallop Dredge**	**All**	**All**		**18.72**	**1.01**
2015	**NE**	**All**	**All**	**All**		**46.13**	**0.59**
2015	MA	Bottom Otter Trawl	Fall	Smb	0.19	17.31	1.25
2015	**MA**	**Bottom Otter Trawl**	**All**	**All**		**17.31**	**1.25**
2015	MA	Sea Scallop Dredge	Spring	Sca	0.05	53.46	0.50
2015	MA	Sea Scallop Dredge	Fall	Sca	0.18	68.28	1.26
2015	**MA**	**Sea Scallop Dredge**	**All**	**All**		**121.74**	**0.74**
2015	**MA**	**All**	**All**	**All**		**139.05**	**0.66**
2015	**All**	**All**	**All**	**All**		**185.19**	**0.52**
2016	NE	Bottom Otter Trawl	Fall	Msp	0.04	7.44	1.25
2016	**NE**	**Bottom Otter Trawl**	**All**	**All**		**7.44**	**1.25**
2016	NE	Gillnet	Summer	Ska	>0.01	11.86	1.28
2016	**NE**	**Gillnet**	**All**	**All**		**11.86**	**1.28**
2016	NE	Sea Scallop Dredge	Spring	Sca	0.03	22.07	0.80
2016	**NE**	**Sea Scallop Dredge**	**All**	**All**		**22.07**	**0.80**
2016	**NE**	**All**	**All**	**All**		**41.38**	**0.61**
2016	MA	Sea Scallop Dredge	Spring	Sca	0.12	45.20	0.56
2016	MA	Sea Scallop Dredge	Winter	Sca	0.07	34.77	0.62
2016	**MA**	**Sea Scallop Dredge**	**All**	**All**		**79.96**	**0.42**
2016	**MA**	**All**	**All**	**All**		**79.96**	**0.42**
2016	**All**	**All**	**All**	**All**		**121.34**	**0.34**

Table 8. Northern Fulmar (*Fulmarus glacialis*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch rate	Estimate	CV
2015	NE	Gillnet	Winter	Msp	0.22	44.91	0.27
2015	NE	Gillnet	Winter	Ska	0.01	5.70	1.28
2015	**NE**	**Gillnet**	**All**	**All**		**50.60**	**0.28**
2015	**NE**	**All**	**All**	**All**		**50.60**	**0.28**
2015	**All**	**All**	**All**	**All**		**50.60**	**0.28**
2016	NE	Gillnet	Fall	Msp	0.03	3.05	1.29
2016	NE	Gillnet	Winter	Dgx	0.08	1.70	1.26
2016	NE	Gillnet	Winter	Msp	0.09	3.76	1.24
2016	**NE**	**Gillnet**	**All**	**All**		**8.51**	**0.76**
2016	**NE**	**All**	**All**	**All**		**8.51**	**0.76**
2016	**All**	**All**	**All**	**All**		**8.51**	**0.76**

Table 9. Northern Gannet (*Morus bassanus*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch rate	Estimate	CV
2015	NE	Gillnet	Spring	Msp	0.02	2.94	1.23
2015	**NE**	**Gillnet**	**All**	**All**		**2.94**	**1.23**
2015	NE	Paired Midwater Trawl	Winter	Her	16.94	148.22	0.45
2015	**NE**	**Paired Midwater Trawl**	**All**	**All**		**148.22**	**0.45**
2015	**NE**	**All**	**All**	**All**		**151.16**	**0.45**
2015	MA	Gillnet	Spring	Dgx	0.02	7.14	1.21
2015	MA	Gillnet	Winter	Dgx	0.01	15.97	1.23
2015	**MA**	**Gillnet**	**All**	**All**		**23.11**	**0.93**
2015	**MA**	**All**	**All**	**All**		**23.11**	**0.93**
2015	**All**	**All**	**All**	**All**		**174.26**	**0.41**
2016	NE	Bottom Otter Trawl	Winter	Msp	0.04	12.17	0.79
2016	**NE**	**Bottom Otter Trawl**	**All**	**All**		**12.17**	**0.79**
2016	**NE**	**All**	**All**	**All**		**12.17**	**0.79**
2016	MA	Bottom Otter Trawl	Spring	Smb	0.28	37.72	0.62
2016	**MA**	**Bottom Otter Trawl**	**All**	**All**		**37.72**	**0.62**
2016	MA	Gillnet	Winter	Cro	0.16	31.18	0.62
2016	**MA**	**Gillnet**	**All**	**All**		**31.18**	**0.62**
2016	MA	Sea Scallop Dredge	Spring	Sca	0.03	8.12	1.34
2016	**MA**	**Sea Scallop Dredge**	**All**	**All**		**8.12**	**1.34**
2016	**MA**	**All**	**All**	**All**		**77.02**	**0.42**
2016	**All**	**All**	**All**	**All**		**89.19**	**0.38**

Table 10. Red-throated Loon (*Gavia stellata*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch rate	Estimate	CV
2015	MA	Gillnet	Spring	Men	0.64	47.51	1.12
2015	MA	Gillnet	Winter	Dgx	0.05	12.26	1.13
2015	**MA**	**Gillnet**	**All**	**All**		**59.77**	**0.92**
2015	**MA**	**All**	**All**	**All**		**59.77**	**0.92**
2015	**All**	**All**	**All**	**All**		**59.77**	**0.92**
2016	MA	Gillnet	Spring	Dgx	0.33	129.47	0.31
2016	MA	Gillnet	Spring	Sbt	0.27	3.09	1.12
2016	MA	Gillnet	Winter	Dgx	0.05	92.19	0.38
2016	MA	Gillnet	Winter	Shd	13.13	328.69	0.27
2016	**MA**	**Gillnet**	**All**	**All**		**553.44**	**0.19**
2016	**MA**	**All**	**All**	**All**		**553.44**	**0.19**
2016	**All**	**All**	**All**	**All**		**553.44**	**0.19**

Table 11. Sooty Shearwater (*Puffinus griseus*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch rate	Estimate	CV
2015	NE	Gillnet	Spring	Msp	0.10	5.45	1.24
2015	NE	Gillnet	Summer	Ska	0.00	6.94	0.80
2015	NE	Gillnet	Fall	Msp	0.12	3.83	1.27
2015	**NE**	**Gillnet**	**All**	**All**		**16.22**	**0.62**
2015	**NE**	**All**	**All**	**All**		**16.22**	**0.62**
2015	**All**	**All**	**All**	**All**		**16.22**	**0.62**
2016	NE	Bottom Otter Trawl	Fall	Msp	0.02	6.10	1.32
2016	**NE**	**Bottom Otter Trawl**	**All**	**All**		**6.10**	**1.32**
2016	NE	Gillnet	Summer	Ska	0.01	12.26	1.28
2016	NE	Gillnet	Fall	Dgx	0.01	10.40	1.23
2016	NE	Gillnet	Fall	Ska	0.04	52.16	0.39
2016	**NE**	**Gillnet**	**All**	**All**		**74.83**	**0.38**
2016	**NE**	**All**	**All**	**All**		**80.93**	**0.37**
2016	**All**	**All**	**All**	**All**		**80.93**	**0.37**

Table 12. Common Murres (*Uria aalge*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fisheries management plan (FMP). Totals for each year by region and by gear combination are summarized in bold font. Region abbreviations are NE for the Northeast and MA for the Mid-Atlantic. Seasons are defined by calendar quarter, FMP abbreviations can be found in Table 2, and bycatch rates are bycaught seabirds per metric tons for fixed gear and landings for mobile gear.

Year	Region	Gear	Season	FMP	Bycatch rate	Estimate	CV
2015	NE	Gillnet	Winter	Dgx	0.15	6.40	0.79
2015	NE	Gillnet	Winter	Msp	0.03	3.39	0.79
2015	NE	Gillnet	Winter	Ska	0.01	12.48	0.79
2015	**NE**	**Gillnet**	**All**	**All**		**22.28**	**0.51**
2015	**NE**	**All**	**All**	**All**		**22.28**	**0.51**
2015	**All**	**All**	**All**	**All**		**22.28**	**0.51**
2016	NE	Gillnet	Winter	Ska	0.02	15.78	0.80
2016	**NE**	**Gillnet**	**All**	**All**		**15.78**	**0.80**
2016	**NE**	**All**	**All**	**All**		**15.78**	**0.80**
2016	**All**	**All**	**All**	**All**		**15.78**	**0.80**

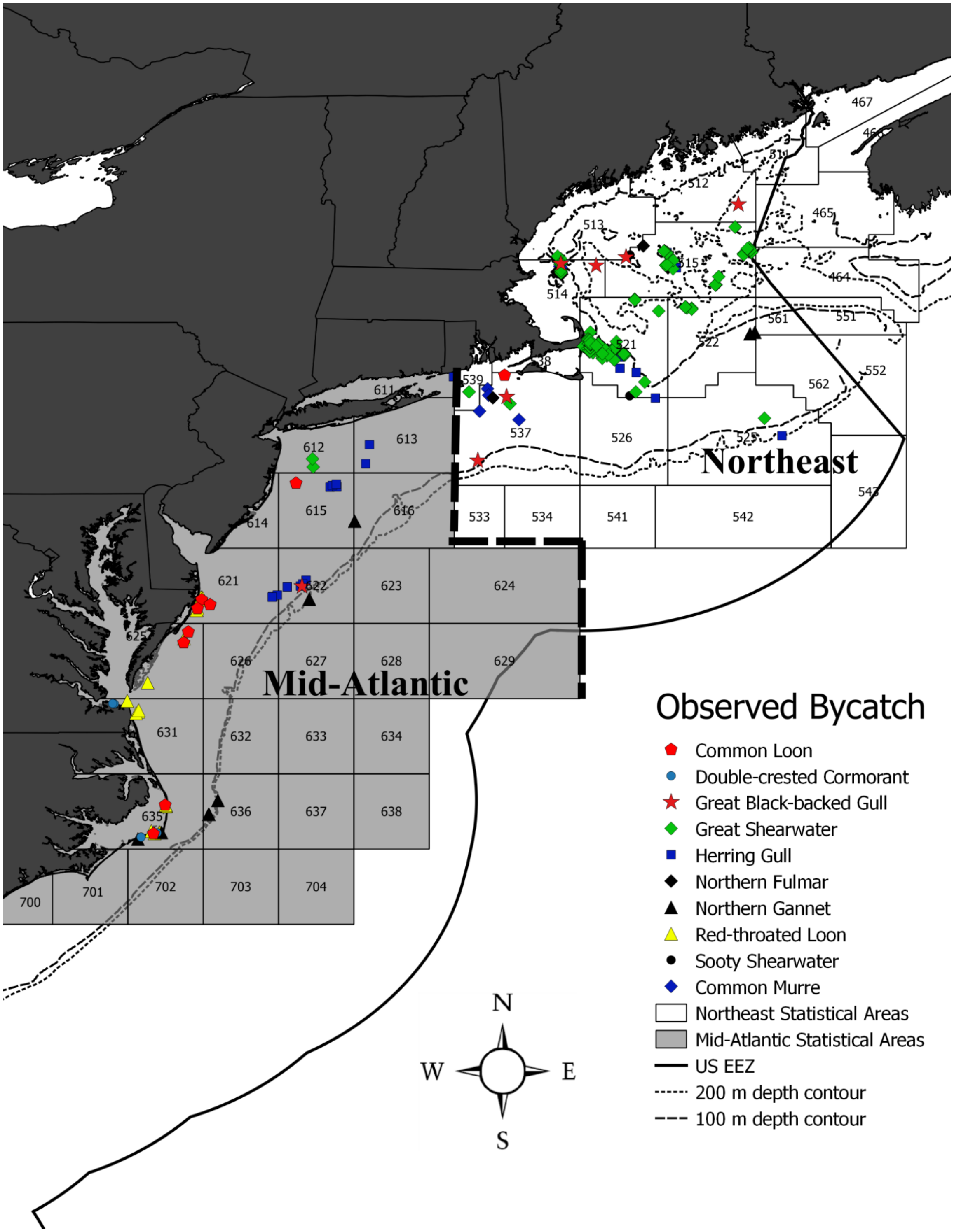

Figure 1. Map of seabird bycatch in the Northeast and Mid-Atlantic regions in 2015 and 2016 for Common Loon (*Gavia immer*), Double-crested Cormorant (*Phalacrocorax auritus*), Great Black-backed Gull (*Larus marinus*), Great Shearwater (*Puffinus gravis*), Herring Gull (*Larus smithsonianus*), Northern Fulmar (*Fulmarus glacialis*), Northern Gannet (*Morus bassanus*), Red-throated Loon (*Gavia stellata*), Sooty Shearwater (*Puffinus griseus*), Common Murre (*Uria aalge*).

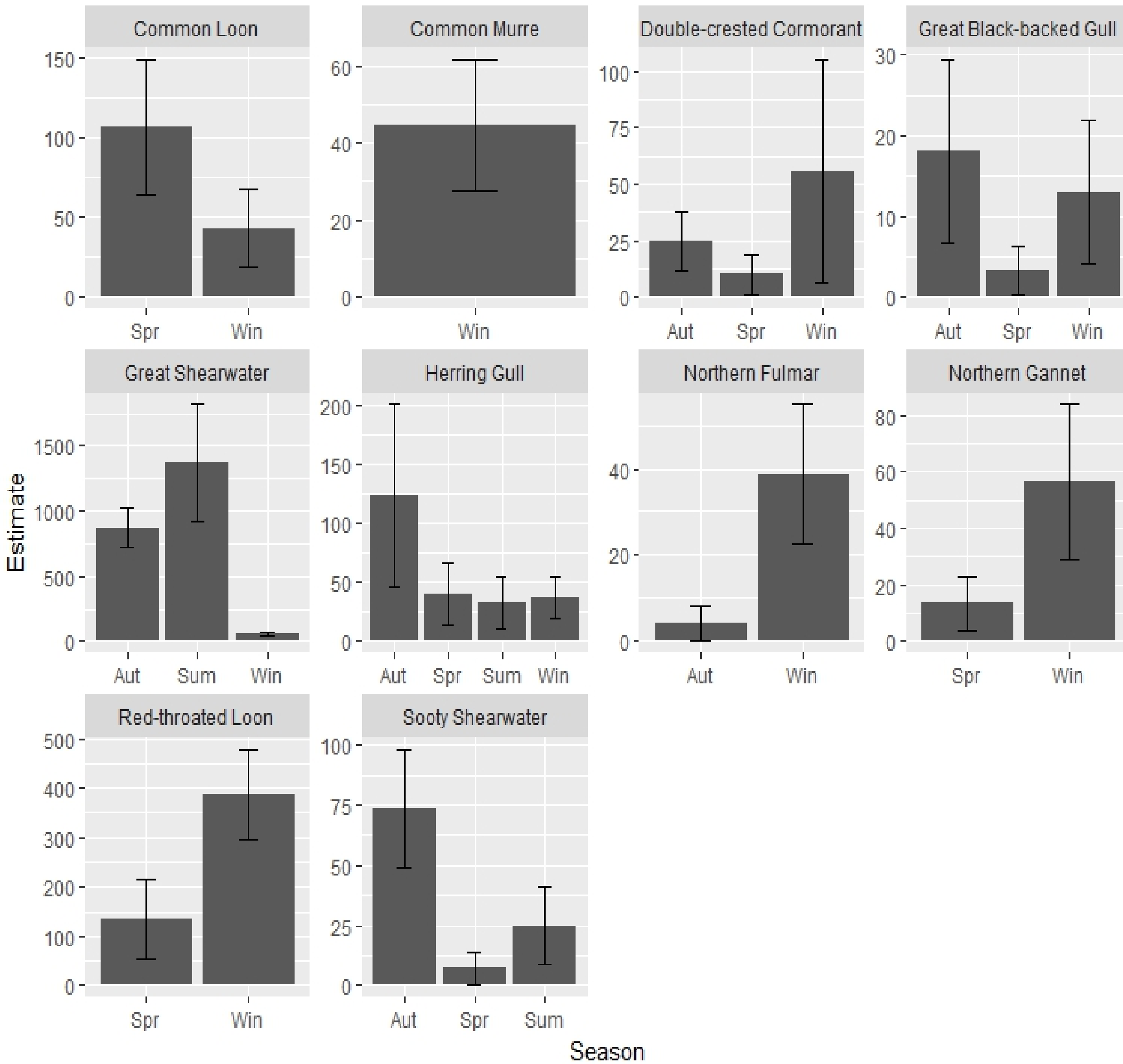

Figure 2. Seasonal estimates of seabird bycatch by species for 2015 and 2016 combined for Common Loon (*Gavia immer*), Common Murre (*Uria aalge*), Double-crested Cormorant (*Phalacrocorax auritus*), Great Black-backed Gull (*Larus marinus*), Great Shearwater (*Puffinus gravis*), Herring Gull (*Larus smithsonianus*), Northern Fulmar (*Fulmarus glacialis*), Northern Gannet (*Morus bassanus*), Red-throated Loon (*Gavia stellata*), Sooty Shearwater (*Puffinus griseus*).

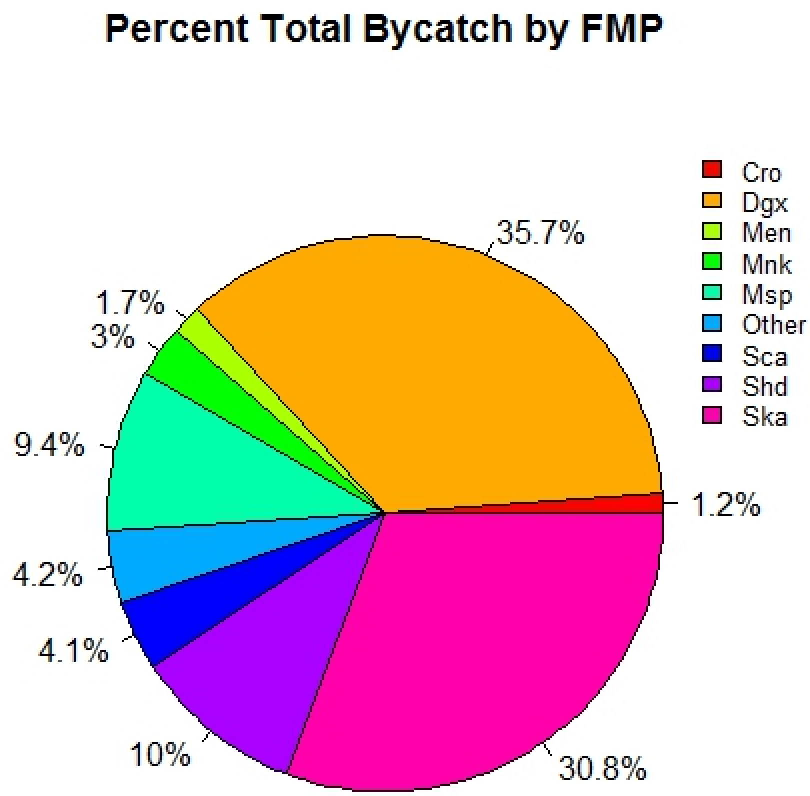

Figure 3. Percentage of total seabird bycatch in 2015 and 2016 by fishery management plan (FMP) for all species and years combined. Definitions for fisheries management plans (FMPs) can be found in Table 2.

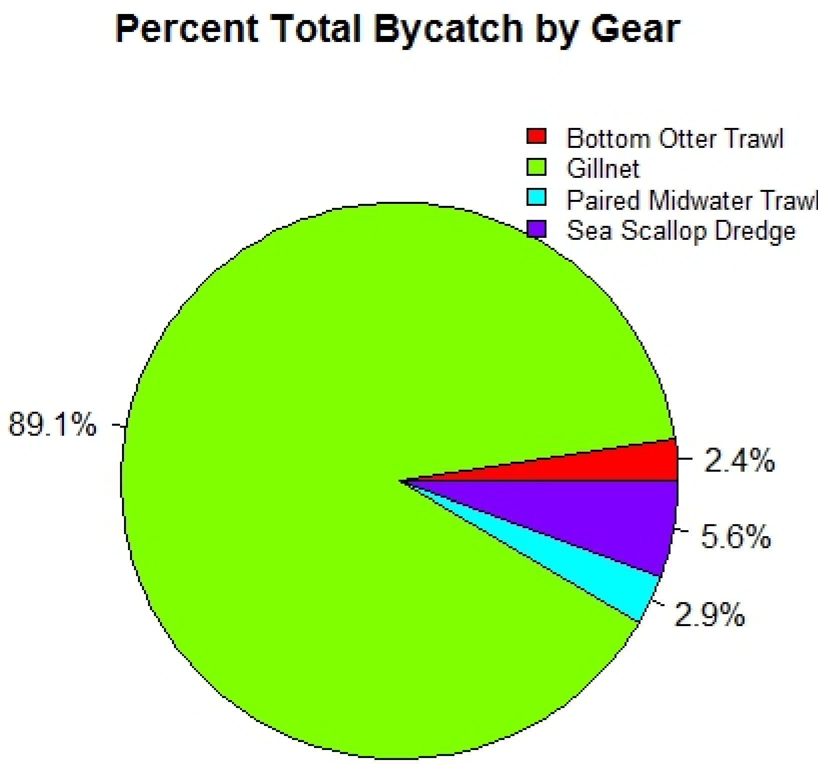

Figure 4. Percentage of total seabird bycatch in 2015 and 2016 by gear type for all species and years combined.

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