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Estimates of seabird bycatch in commercial fisheries off the Northeast and Mid-Atlantic coasts of the United States from 2017-2019

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National Oceanic and Atmospheric Administration
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ABSTRACT

This report provides bycatch estimates for 10 species of seabirds caught in commercial fisheries off the Northeast and Mid-Atlantic coasts of the United States during the years of 2017 through 2019. A total of 1570 birds were recorded as bycatch in commercial fishing gear, with 1477 birds from the Northeast region and 93 birds in the Mid-Atlantic region. From 2017-2019, the annual total bycatch estimates among all gear types, respectively, included 133 (CV=0.41), 216 (CV=0.65), and 21 (CV=0.68) common loons (*Gavia immer*); 15 (CV=0.73), 49 (CV=1.06), and 5 (CV=1.26) double-crested cormorants (*Phalacrocorax auritus*); 32 (CV=0.58), 40 (CV=0.59) and 71 (CV=0.45) great black-backed gulls (*Larus marinus*); 3795 (CV=0.06), 1371 (CV=0.16), and 883 (CV=0.11) great shearwaters (*Puffinus gravis*); 75 (CV=0.63), 35 (CV=0.67), and 102 (CV=0.35) herring gulls (*Larus smithsonianus*); 9 (CV=0.62), 6 (CV=0.94), and 6 (CV=1.00) northern fulmars (*Fulmarus glacialis*); 320 (CV=0.13), 85 (CV=0.39), and 30 (CV=0.76) northern gannets (*Morus bassanus*); 274 (CV=0.28), 550 (CV=0.26), and 24 (CV=0.73) red-throated loons (*Gavia stellata*); 320 (CV=0.21), 148 (CV=0.60), and 13 (CV=1.05) sooty shearwaters (*Puffinus griseus*); and 6 (CV=1.25), 5 (CV=0.81), and 13 (CV=0.56) thin-billed murres (*Uria aalge*).

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 between the U.S. Department of Commerce National Marine Fisheries Service and U.S. Department of Interior Fish and Wildlife Service established a legal framework for conservation of migratory birds, in particular seabirds. Under this Memorandum, bycatch analyses of seabird species and assessments of the population level effects are encouraged.

To fulfill this requirement, Warden (2010) estimated interactions of common loons (*Gavia immer*) and red-throated loons (*Gavia stellata*) in the Northeast and Mid-Atlantic gillnet fisheries from 1996-2007. More recently, Hatch (2017) conducted a comprehensive analysis of bycatch for 10 species of seabirds across 6 gear types from 1996-2014. These estimates were updated for the years 2015 and 2016 by Sigourney et al. (2018).

The present study builds on these previous studies to estimate seabird bycatch from 2017-2019. We estimated bycatch for 10 species of seabirds in the 4 gear types in the Northeast and Mid-Atlantic U.S. fisheries that had documented bycatch. A bycatch event was defined as any interaction of a seabird with commercial fishing gear. We considered all interactions to be bycatch and did not distinguish between non-serious injury, serious injury, or mortality. We assessed bycatch for fixed (i.e., gillnets) and mobile (i.e., bottom otter trawls, paired midwater trawls, and sea scallop dredges) gear types**.** In addition, due to the uncommon practice of attaching bait to gillnets that resulted in extremely large numbers of bycaught birds, we investigated the effect of baiting gillnet gear on bycatch. 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 U.S. Northeast and Mid-Atlantic observed seabird bycatch and observer coverage for 2017, 2018, and 2019, 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 on a wide range of variables including kept and discarded catch, configuration of fishing gear, and protected species interactions (Fisheries Sampling Branch 2016). The ASM observers collect a reduced number of variables in comparison to the NEFOP observers, where the ASM program is focused primarily on groundfish catch in the Northeast region. Approximately 94% of all records came from the NEFOP and 6% came from the ASM program.

Commercial Fishing Data

We obtained the total commercial fishing effort from mandatory vessel trip reports. Fishing effort was defined by the most appropriate gear-specific unit of fishing effort. For mobile gears (i.e., bottom otter trawls, paired midwater trawls, and sea scallop dredges), we defined fishing effort as the total number of days gear were fished, which we calculated using the equation,

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

where gear quantity was defined as the number of nets towed per haul within a trip and number of hauls was defined as the number of hauls per trip. For fixed gillnet gear types, we summarized effort using total fishery landings following the same protocols as Hatch (2017) and Sigourney et al. (2018). The vessel trip reports 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 vessel trip reports for fixed gear types are prone to be biased low (Murray 2009), we augmented information on total effort with information contained in other databases. This included the Commercial Fisheries Biological Sample Database for most areas that record the seafood dealer weigh-out slips. However, for the state of North Carolina, federal data from the vessel trip reports and Commercial Fisheries Biological Sample Database 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 regard 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 using the same methods 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 macro combination (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, Fishery Management Plan (FMP; Table 1) and whether or not baiting nets was documented. In the few cases where the observed fishing effort for a stratum was greater than its total fishing effort as derived from the Vessel Trip Reports and other effort databases, then the observed fishing effort was considered a complete census for that stratum and therefore was not estimated in the analysis (Table 2). Seasons were defined by calendar quarters (Winter=January-March; Spring=April-June; Summer=July-September; and Fall=October-December).

For all strata where observers did not document any bycatch of seabirds, we assumed the total bycatch to be 0. For strata with observed bycatch, we fitted a Bayesian model with the following hierarchical structure:

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

$$\alpha_{ij} \sim \text{Gamma}(rate_{ij}, shape_{ij})$$
$$\beta_{ij} \sim \text{Gamma}(rate_{ij}, shape_{ij}) \text{ or } \beta_{ij} \sim \exp(rate_{ij})$$

where y_{ijs} was the observed number of bycaught animals of species *i* in gear *j* and stratum *s*, e_{js} was the observed fishing effort of gear *j* in stratum *s*, λ_{ijs} was the estimated bycatch rate for species *i* in gear *j* and stratum *s*, and α_{ij} and β_{ij} were hyperparameters specific to species *i* and gear *j* that were 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 the most recent previous bycatch estimates (Sigourney et al. 2018). Sigourney et al. (2018) had used the results of Hatch (2017) to construct informative hyperparameters; therefore, the updated hyperparameters used in this study were effectively informed from all data on bycatch from 1996-2016. Specifically, we fitted separate gamma distributions to the posterior distributions of the ⟨ij and ®ij that were estimated in Sigourney et al. (2018) 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 ⟨ij and ®ij in the analyses of the new data (2017-2019). For 2 species-gear combinations (sooty shearwaters [*Puffinus griseus]*-bottom otter trawl and great black-backed gull [*Larus marinus*]-sea scallop dredge), an exponential distribution provided a better fit to the Hatch (2017) posteriors of ®ij and was therefore used in lieu of a gamma distribution. In addition, there were 4 new species-gear combinations (common loon-sea scallop dredge, double-crested cormorant [*Phalacrocorax auritus*]-bottom otter trawl, northern fulmar [*Fulmarus glacialis*]-bottom otter trawl, and sooty shearwater-sea scallop dredge) where we used uninformative hyperpriors ⟨ ~ Exponential(1) and β ~ Gamma(0.1, 100) following the original analysis by Hatch (2017).

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 ($\lfloor_{ijs}$) by the measured total fishing effort for gear *j* in stratum *s* (E_{js})*:*

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

For all parameters of interest, we sampled from the joint posterior distribution using Markov Chain Monte Carlo sampling algorithms implemented in the software packages R and Just Another Gibbs Sampler (JAGS; Plummer 2003). Model convergence was assessed by calculating Gelman-Rubin statistics and examining trace plots. 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 where region was defined using the same criteria from Sigourney et al. (2018). Annual- and region-specific estimates of bycatch were estimated by summing the appropriate strata-specific estimates. Following the delta method, variances were calculated by summing the variances of the strata-specific estimates.

Baiting

A preliminary review of the observer data indicated that baiting gear primarily occurred in the gillnet fishery and often resulted in large numbers of bycatch per haul of shearwaters (great shearwaters [*Puffinus gravis*] and sooty shearwaters). These rare but large bycatch numbers were statistical outliers that highly skewed the results for the corresponding strata for these species. Therefore, to control for the effect of baiting in gillnets on bycatch rates and total bycatch estimates for shearwaters, we created a new baiting stratum. We searched the comments field in the observer database for mentions of "bait" or "baiting," and for each observed vessel trip, we assigned all bycatch events from that trip to the baiting stratum if the comment field unambiguously stated that the gear was baited. These events and the corresponding observer effort were subsequently removed from the dataset prior to analysis. The observed bycatch from the baited nets was then added to the final estimates from the analysis to estimate total bycatch for those strata where baiting occurred.

RESULTS

Fisheries observers and monitors documented 1570 seabird bycatch events from 2017-2019. Bycatch included 10 species across 4 gear types (Table 2). The majority of observed bycatch was of great shearwaters (1247) followed by sooty shearwaters (89), northern gannets (*Morus bassanus*; 75), red-throated loons (48), herring gulls (*Larus smithsonianus*; 35), great black-backed gulls (22), common loons (21), thin-billed murres (*Uria aalge*; 16), double-crested cormorants (10), and northern fulmars (7). The majority of seabird interactions occurred in gillnets (1344; Figure 1) followed by sea scallop dredges (107; Figure 2), paired midwater trawls (61; Figure 3), and bottom otter trawls (58; Figure 4).

We documented a total of 757 and 65 bycatch events from baited gillnets for great shearwaters and sooty shearwaters, respectively. For both species, the majority of events occurred in the summer and in Statistical Area 521 (Table 3). There was some annual variation with >88% of the documented baiting occurring in 2017 and none documented in 2018. The greatest number

of events occurred in the skate fishery (~80%) followed by the dogfish fishery (~20%), and only one event occurred in the monkfish fishery (Table 3).

Total estimates of seabird bycatch for each species-gear combination are found in Tables 4-13. Seasonal bycatch patterns varied by species, where bycatch patterns ranged from great black-backed gulls and herring gulls documented year round to thin-billed murres only documented in winter (Figure 5). Annual bycatch patterns also varied by species, where bycatch patterns ranged from northern fulmar bycatch that was fairly constant from 2017-2019 to great black-backed gull bycatch that increased over the years while great shearwater and northern gannet bycatch decreased over the years (Figure 6). Variation among FMPs was evident, with the highest percentage of overall bycatch (47.4%) occurring in the skate fishery (Figure 7). Over 78% of the total bycatch estimated was in the gillnet fishery, while less than 4% was in the paired midwater trawl fishery (Figure 8).

In 2017, total bycatch estimates among all gear types included 133 (CV=0.41) common loons, 15 (CV=0.73) double-crested cormorants, 32 (CV=0.58) great black-backed gulls, 3795 (CV=0.06) great shearwaters, 75 (CV=0.63) herring gulls, 9 (CV=0.62) northern fulmars, 320 (CV=0.13) northern gannets, 274 (CV=0.28) red-throated loons, 320 (CV=0.21) sooty shearwaters, and 6 (CV=1.25) thin-billed murres.

In 2018, total bycatch estimates among all gear types included 216 (CV=0.65) common loons, 49 (CV=1.06) double-crested cormorants, 40 (CV=0.59) great black-backed gulls, 1371 (CV=0.16) great shearwaters, 35 (CV=0.67) herring gulls, 6 (CV=0.94) northern fulmars, 85 (CV=0.39) northern gannets, 550 (CV=0.26) red-throated loons, 148 (CV=0.60) sooty shearwaters, and 5 (CV=0.81) thin-billed murres.

In 2019, total bycatch estimates among all gear types included 21 (CV=0.68) common loons, 5 (CV=1.26) double-crested cormorants, 71 (CV=0.45) great black-backed gulls, 883 (CV=0.11) great shearwaters, 102 (CV=0.35) herring gulls, 6 (CV=1.00) northern fulmars, 30 (CV=0.76) northern gannets, 24 (CV=0.73) red-throated loons, 13 (CV=1.05) sooty shearwaters, and 13 (CV=0.56) thin-billed murres.

Regional variation in bycatch was evident for some species (see Tables 4-13). Bycatch of northern fulmars, sooty shearwaters, and thin-billed murres only occurred in the Northeast region, whereas bycatch of red-throated loons only occurred in the mid-Atlantic region. In addition, the majority of bycatch of great shearwaters (>99%) and great black-backed gulls (>95%) occurred in the Northeast region. For all other species, bycatch did not differ greatly among regions.

DISCUSSION

From 2017-2019, fisheries observers and monitors documented 10 bycaught seabird species in 4 gear types. The bycatch patterns observed in these years were largely consistent with the dominant patterns observed in previous years as reported by Hatch (2017) and Sigourney et al. (2018). For example, gillnets continue to be the most dominant gear type involved in seabird interactions; great shearwaters dominated bycatch in the Northeast; and red-throated loons dominated bycatch in the Mid-Atlantic. For each species, seasonal bycatch patterns were also similar to the previous studies. In addition, we documented that baited gillnets were responsible for a majority of the observed bycatch of great shearwaters and sooty shearwaters.

Approximately 78% of all seabird bycatch occurred in gillnet fisheries. In particular, the skate gillnet fishery accounted for the highest overall proportion of bycatch mostly due to high bycatch of great shearwaters. This aligned with Hatch (2017) and Sigourney et al. (2018) who both

reported that >80% of all seabird bycatch occurred in gillnets. 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 is needed to determine the characteristics of gillnet fisheries that influence susceptibility of seabirds to bycatch.

Although gillnets were the most prominent gear type, there were some species-specific differences. For example, gulls were more common in bottom otter trawls and sea scallop dredges than in gillnets. Similar to Hatch (2017) and Sigourney et al. (2018), we also found that northern gannets were particularly susceptible to paired midwater trawls and accounted for 100% of all observed bycatch in this gear. Seasonal migrations and feeding biology likely influence these species-gear interactions. For example, northern gannets are known to occur in large numbers off New Jersey during winter months and feed heavily on menhaden (*Brevoortia tyrannus*) which may make them particularly vulnerable to paired midwater trawls (Veit et al. 2015). Understanding these complex relationships between seabird biology and fisheries interactions are needed to aid future mitigation efforts.

Temporal variability was species dependent and largely congruent with past studies (Hatch 2017; Sigourney et al. 2018). For shearwaters, bycatch occurred primarily in summer months whereas bycatch of northern gannets and thin-billed murres was most common in winter months. In contrast, gulls showed relatively little seasonal variation in bycatch (particularly black-backed gulls, which were observed in similar numbers in every season). These patterns are assumed to be driven by the breeding, migratory patterns, and magnitude of annual fluctuations of the different species (Nisbet et al. 2013; Hatch 2017). Across all species and all gear types, bycatch was highest in 2017 and lowest in 2019. This pattern was most evident for great shearwaters, sooty shearwaters, and northern gannets. Reasons for these annual fluctuations in bycatch could be due to changes in foraging patterns, fishing locations, fishing techniques, or quality of the gears used.

Our summary of documented baiting revealed that bycatch in baited gillnets primarily occurred during summer and early fall. Spatially, a preponderance of bycatch events from baited gillnets were documented in statistical area 521. This area was also highlighted by Hatch et al. (2016) as an area of high overlap with great shearwater habitat use and fishing activity. Hatch et al. (2016) also noted that baiting of nets may have influenced bycatch rates in this region**.** Seabird behavior can be influenced by the type of fishing activity that occurs in a region (Bodey et al. 2014). The presence of baiting in this area during seasons when shearwaters are present may induce behavioral changes in foraging that result in increased bycatch events with baited gear.

There was considerable annual variation in observed bycatch from baited gillnets with large numbers of shearwaters observed only in 2017. This highlights the potential influence of fisher behavior on spatiotemporal patterns of bycatch. For example, large bycatch events are likely to be costly and time consuming and therefore may incentivize fishers to forego or delay baiting in the presence of birds in subsequent trips. This dynamic will inevitably result in unexplained autocorrelation in bycatch rates if baiting is ignored in the estimation analysis. As such, understanding the relationship between fisher behavior and bycatch patterns, though challenging, is a crucial step to untangling patterns and calculating more precise estimates of total bycatch.

The observed difference in bycatch between gillnets that were known to be baited and gillnets that were known to be unbaited indicates that baited gillnets have a markedly higher bycatch rate than unbaited gillnets for shearwater species. Ideally, we would treat baited gear as a separate strata and estimate the total amount of bycatch from baited gear separately from unbaited gear. Unfortunately, information on the frequency and extent of baiting is lacking, thus precluding such an analysis. Comments on baiting are recorded voluntarily, and there is no dedicated field for

observers to record whether or not gear was baited (Hatch et al. 2016). In addition, there is no information in the landings data to be able to accurately allocate the amount of total effort to baited gear. We explored the option of assigning specific vessels to a separate strata if baiting was ever observed on any hauls, but this approach implicitly assumes that these vessels always bait their gear during a specific area and time. Information in the comments suggested that vessels that do bait their gear may only do so intermittently. As such, it is difficult to accurately estimate the bycatch rate of baited gillnets without this type of additional information. Our approach here was to assume that all baited activity was observed. This conservative assumption was mostly likely not true, so the total number of shearwaters bycaught is underestimated by an unknown amount.

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 (Gelman and Hill 2007). Using the Bayesian machinery, we were able to update estimates of bycatch that were informed from the results of prior studies without having to re-analyze 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. However, as with the previous studies, we did not attempt to estimate bycatch in strata where no observations of bycatch occurred, even if there was prior observed bycatch. Recently, Authier et al. (2021) used simulations to explore a multilevel regularized regression method for analyzing non-representative samples of bycatch under scenarios of both undersampling and oversampling. In the future, this method could be adapted to seabird bycatch estimation in the U.S. Atlantic waters to derive more complete and precise estimates for all strata as well as to investigate temporal trends in bycatch.

TABLES AND FIGURES

Table 1. Definitions and abbreviations for fishery management plans (FMPs).

FMP	Description
Cro	**Atlantic croaker** (*Micropogonias undulates*)
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*)
Lob	**American lobster (***Homarus americanus***)**
Men	**Atlantic menhaden** (*Brevoortia tyrannus*)
Mnk	**Monkfis**h (*Lophius americanus*)
Msp	**Northeast multispecies (groundfish)** Atlantic cod (*Gadus morhua*) Haddock (*Melanogrammus aeglefinus*) Yellowtail flounder (*Limanda ferruginea*) 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*) 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	**Shad** (*Alosa sapidissima*) **and river herring** Alewife (*Alosa pseudoharengus*) Blueback herring (*Alosa aestivalis*)
Ska	**Northeast skate complex** Winter skate (*Leucoraja ocellata*) Barndoor skate (*Dipturis laevis*) Thorny skate (*Amblyraja radiata*) Smooth skate (*Malacoraja senta*) Little skate (*Leucoraja erinacea*) Clearnose skate (*Raja eglanteria*) Rosette skate (*Leucoraja garmani*)

FMP	Description
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*)

Table 2. 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 otter trawl, SSD=sea scallop dredge, PMT=paired midwater trawl. Seasons were defined by calendar quarter (Winter=January-March; Spring=April-June, Summer=July-September, and Fall=October-December). Fishery management plan (FMP) abbreviations are in Table 1. Effort was 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	2017	Fall	Spt	625	1	12.7	21.6	59.1
	GN	2017	Fall	Spw	635	1	>0.1	>0.1	100*
	GN	2017	Spring	Fsb	539	2	0.8	21.5	3.7
	GN	2017	Spring	Ska	539	1	19.1	167.7	11.4
	GN	2017	Spring	Ska	613	1	23.8	431.0	5.5
	GN	2017	Summer	Fsb	539	2	1.4	33.4	4.2
	GN	2017	Winter	Dgx	621	1	50.6	406.1	12.5
	GN	2017	Winter	Ska	521	1	12.0	119.6	10.0
	GN	2018	Fall	Spb	611	1	2.2	0.8	100*
	GN	2018	Spring	Dgx	621	1	5.4	14.5	37.3
	GN	2018	Spring	Ska	539	2	2.4	118.1	2.0
	GN	2018	Summer	Ska	539	1	2.3	264.3	0.9
	GN	2018	Winter	Dgx	625	1	23.5	214.3	10.9
	GN	2019	Fall	Dgx	537	1	2.2	1.2	100*
	GN	2019	Spring	Dgx	631	1	67.2	386.9	17.4
	GN	2019	Winter	Dgx	631	1	238.7	1289.1	18.5
	GN	2019	Winter	Mnk	612	1	21.7	211.9	10.2
	SSD	2018	Winter	Sca	526	1	90.7	714.9	12.7
	All	**All**	**All**	**All**	**All**	**21**	**576.7**	**4417.0**	**13.1**
Double-Crested Cormorant (*Phalacrocorax auritus*)	BOT	2019	Fall	Fsb	616	1	13.1	76.3	17.1
	GN	2017	Fall	Cro	625	2	1.5	2.2	68.4
	GN	2017	Fall	Spt	625	2	12.7	21.6	59.1
	GN	2017	Summer	Ska	539	1	25.6	236.9	10.8

Species	Gear	Year	Season	FMP	Area	Observed Bycatch	Observed Effort	Total Effort	% Coverage
	GN	2018	Fall	Msp	515	1	7.7	21.5	35.8
	GN	2018	Fall	Spb	613	1	1.2	54.6	2.1
	GN	2018	Spring	Cro	631	2	1.9	3.0	62.1
	All	**All**	**All**	**All**	**All**	**10**	**63.7**	**416.1**	**255.4**
Great Black-Backed Gull (*Larus marinus*)	BOT	2017	Fall	Msp	515	1	66.3	412.3	16.1
	BOT	2017	Summer	Smb	537	1	151.3	667.6	22.7
	BOT	2017	Winter	Mnk	521	1	27.1	76.2	35.6
	BOT	2018	Summer	Msp	514	1	22.5	255.5	8.8
	BOT	2018	Summer	Msp	521	1	10.9	166.3	6.5
	BOT	2018	Winter	Msp	513	1	29.5	223.9	13.2
	BOT	2019	Fall	Msp	515	1	59.3	247.0	24.0
	BOT	2019	Fall	Sms	539	1	3.4	45.8	7.3
	BOT	2019	Summer	Smb	537	1	64.5	598.6	10.8
	BOT	2019	Winter	Msp	513	1	34.4	284.4	12.1
	BOT	2019	Winter	Smb	539	1	0.5	7.3	6.4
	GN	2017	Fall	Ska	521	1	306.7	1741.9	17.6
	GN	2018	Spring	Mnk	537	1	120.3	876.7	13.7
	GN	2018	Winter	Msp	513	2	67.8	197.0	34.4
	GN	2019	Fall	Msp	513	1	37.7	118.0	32.0
	GN	2019	Spring	Mnk	513	1	5.0	18.2	27.5
	SSD	2017	Spring	Sca	514	1	31.5	389.2	8.1
	SSD	2017	Winter	Sca	622	1	49.7	312.8	15.9
	SSD	2018	Fall	Sca	522	1	15.0	198.3	7.6
	SSD	2019	Spring	Sca	521	2	55.5	731.4	7.6
	All	**All**	**All**	**All**	**All**	**22**	**1158.8**	**7568.5**	**15.3**
Great Shearwater** (*Puffinus gravis*)	BOT	2017	Summer	Msp	522	1	12.2	147.8	8.2
	BOT	2017	Summer	Smb	622	1	13.6	46.5	29.1
	BOT	2019	Fall	Msp	515	1	59.3	247.0	24.0

Species	Gear	Year	Season	FMP	Area	Observed Bycatch	Observed Effort	Total Effort	% Coverage
	BOT	2019	Fall	Ska	539	1	12.9	57.6	22.4
	BOT	2019	Summer	Smb	526	14	13.5	155.2	8.7
	GN	2017	Fall	Dgx	513	1	4.3	11.7	36.9
	GN	2017	Fall	Dgx	514	1	4.4	19.3	22.7
	GN	2017	Fall	Dgx	521	35	60.0	513.0	11.7
	GN	2017	Fall	Mnk	513	3	25.3	100.2	25.2
	GN	2017	Fall	Mnk	514	27	71.2	186.8	38.1
	GN	2017	Fall	Mnk	521	1	2.0	4.6	43.6
	GN	2017	Fall	Msp	513	1	11.6	51.9	22.3
	GN	2017	Fall	Msp	515	9	21.7	70.8	30.6
	GN	2017	Fall	Msp	521	3	6.6	8.5	77.8
	GN	2017	Fall	Ska	521	115	306.7	1741.9	17.6
	GN	2017	Summer	Dgx	513	3	24.4	355.3	6.9
	GN	2017	Summer	Dgx	521	117	93.6	1424.9	6.6
	GN	2017	Summer	Lob	521	1	0.0	1.3	0.9
	GN	2017	Summer	Mnk	513	1	25.6	226.4	11.3
	GN	2017	Summer	Mnk	515	1	7.2	65.3	11.1
	GN	2017	Summer	Msp	513	1	12.5	73.2	17.1
	GN	2017	Summer	Msp	521	1	1.3	14.7	8.5
	GN	2017	Summer	Ska	521	604	155.0	2233.9	6.9
	GN	2017	Summer	Ska	539	2	25.6	236.9	10.8
	GN	2018	Summer	Dgx	514	1	16.2	100.0	16.2
	GN	2018	Summer	Dgx	521	8	13.0	759.9	1.7
	GN	2018	Summer	Msp	513	8	10.0	166.6	6.0
	GN	2018	Summer	Msp	561	1	6.0	14.9	40.5
	GN	2018	Summer	Ska	521	5	57.9	2622.5	2.2
	GN	2019	Fall	Dgx	513	11	1.4	5.2	26.9
	GN	2019	Fall	Dgx	514	15	0.7	1.4	49.8

Species	Gear	Year	Season	FMP	Area	Observed Bycatch	Observed Effort	Total Effort	% Coverage
	GN	2019	Fall	Dgx	521	9	24.2	384.0	6.3
	GN	2019	Fall	Mnk	513	1	19.6	132.6	14.8
	GN	2019	Fall	Mnk	514	1	40.5	176.9	22.9
	GN	2019	Fall	Msp	513	29	37.7	118.0	32.0
	GN	2019	Fall	Msp	514	2	5.6	29.3	19.2
	GN	2019	Fall	Ska	521	3	111.7	1070.1	10.4
	GN	2019	Summer	Dgx	521	7	68.4	864.9	7.9
	GN	2019	Summer	Mnk	513	1	56.6	298.8	18.9
	GN	2019	Summer	Mnk	515	7	23.4	107.6	21.7
	GN	2019	Summer	Msp	521	2	12.4	27.2	45.7
	GN	2019	Summer	Ska	521	104	156.4	2466.3	6.3
	GN	2019	Summer	Ska	613	1	11.6	87.2	13.3
	SSD	2017	Fall	Sca	526	1	30.4	250.5	12.1
	SSD	2017	Summer	Sca	526	24	44.4	389.2	11.4
	SSD	2018	Fall	Sca	526	10	151.5	1007.1	15.0
	SSD	2018	Summer	Sca	521	14	24.1	310.0	7.8
	SSD	2018	Summer	Sca	522	3	30.6	427.6	7.2
	SSD	2018	Summer	Sca	525	1	111.2	1600.1	7.0
	SSD	2018	Summer	Sca	526	31	113.2	941.7	12.0
	SSD	2019	Fall	Sca	521	1	20.6	241.7	8.5
	SSD	2019	Summer	Sca	526	1	83.6	936.2	8.9
	All	**All**	**All**	**All**	**All**	**1247**	**2253.8**	**23,532.1**	**9.6**
Herring Gull (*Larus smithsonianus*)	BOT	2017	Fall	Msp	522	1	20.0	57.5	34.8
	BOT	2017	Fall	Smb	539	1	6.9	62.5	11.1
	BOT	2017	Spring	Fsb	611	1	5.7	40.1	14.2
	BOT	2017	Spring	Smb	616	1	12.2	181.3	6.7
	BOT	2017	Winter	Smb	622	1	6.8	58.5	11.6
	BOT	2018	Fall	Sms	539	1	2.7	38.5	7.1

Species	Gear	Year	Season	FMP	Area	Observed Bycatch	Observed Effort	Total Effort	% Coverage
	BOT	2018	Fall	Sms	611	1	3.7	21.1	17.6
	BOT	2018	Spring	Smb	537	1	3.8	52.2	7.4
	BOT	2019	Fall	Fsb	539	1	7.6	59.5	12.8
	BOT	2019	Summer	Msp	514	1	34.5	168.8	20.4
	BOT	2019	Winter	Mnk	521	2	14.4	44.7	32.3
	BOT	2019	Winter	Msp	514	1	29.0	192.8	15.0
	BOT	2019	Winter	Msp	521	1	34.8	251.9	13.8
	BOT	2019	Winter	Ska	537	1	5.6	25.7	21.7
	BOT	2019	Winter	Smb	539	1	0.5	7.3	6.4
	GN	2019	Fall	Ska	521	1	111.7	1070.1	10.4
	GN	2019	Summer	Mnk	513	1	56.6	298.8	18.9
	GN	2019	Summer	Sbt	614	1	4.3	44.1	9.7
	GN	2019	Winter	Msp	513	1	31.5	97.6	32.3
	GN	2019	Winter	Msp	514	1	11.7	10.7	100*
	SSD	2017	Spring	Sca	514	1	31.5	389.2	8.1
	SSD	2017	Spring	Sca	521	2	8.6	296.2	2.9
	SSD	2017	Spring	Sca	526	4	54.9	526.9	10.4
	SSD	2017	Winter	Sca	615	1	71.0	535.8	13.3
	SSD	2017	Winter	Sca	622	1	49.7	312.8	15.9
	SSD	2018	Fall	Sca	526	1	151.5	1007.1	15.0
	SSD	2019	Fall	Sca	522	1	20.1	233.2	8.6
	SSD	2019	Fall	Sca	615	2	17.6	224.4	7.8
	SSD	2019	Winter	Sca	521	1	70.0	666.4	10.5
	All	**All**	**All**	**All**	**All**	**35**	**878.9**	**6975.8**	**12.6**
Northern Fulmar (*Fulmarus glacialis*)	BOT	2018	Winter	Msp	515	1	44.0	182.2	24.1
	GN	2017	Fall	Msp	515	3	21.7	70.8	30.6
	GN	2018	Winter	Msp	513	1	67.8	197.0	34.4
	GN	2019	Fall	Msp	514	1	5.6	29.3	19.2

Species	Gear	Year	Season	FMP	Area	Observed Bycatch	Observed Effort	Total Effort	% Coverage
	GN	2019	Winter	Msp	515	1	23.7	43.1	55.1
	All	**All**	**All**	**All**	**All**	**7**	**162.9**	**522.4**	**31.2**
Northern Gannet (*Morus bassanus*)	BOT	2017	Fall	Fsb	615	1	10.7	44.1	24.2
	BOT	2017	Spring	Her	616	1	0.9	1.9	50.8
	BOT	2017	Winter	Mnk	521	1	27.1	76.2	35.6
	BOT	2017	Winter	-	616	2	0.6	5.4	10.4
	BOT	2018	Fall	Sms	539	1	2.7	38.5	7.1
	BOT	2018	Spring	Smb	616	1	9.6	136.0	7.0
	BOT	2018	Spring	Smb	622	1	4.4	35.5	12.4
	BOT	2018	Winter	Sms	539	1	1.2	20.2	5.8
	BOT	2019	Spring	-	616	1	1.3	0.1	100*
	GN	2018	Winter	Msp	513	1	67.8	197.0	34.4
	GN	2019	Winter	Mnk	537	1	18.2	167.8	10.9
	GN	2019	Winter	Oth	635	1	3.4	59.7	5.8
	GN	2019	Winter	Ska	537	1	100.5	799.8	12.6
	PMT	2017	Winter	Smb	521	54	0.6	3.4	18.2
	PMT	2018	Winter	Smb	612	7	0.7	4.6	15.8
	All	**All**	**All**	**All**	**All**	**75**	**249.8**	**1590.2**	**15.7**
Red-Throated Loon (*Gavia stellata*)	GN	2017	Spring	Dgx	621	2	30.9	392.1	7.9
	GN	2017	Spring	Dgx	625	3	18.0	282.2	6.4
	GN	2017	Spring	Dgx	631	7	46.5	255.9	18.2
	GN	2017	Spring	Oth	635	4	4.9	41.8	11.6
	GN	2017	Winter	Dgx	631	1	72.9	611.7	11.9
	GN	2017	Winter	Shd	635	4	0.5	16.3	3.0
	GN	2018	Spring	Cro	631	3	1.9	3.0	62.1
	GN	2018	Spring	Dgx	625	1	13.9	116.1	12.0
	GN	2018	Spring	Dgx	631	2	19.4	173.6	11.2
	GN	2018	Spring	Dgx	635	1	9.6	91.7	10.5

Species	Gear	Year	Season	FMP	Area	Observed Bycatch	Observed Effort	Total Effort	% Coverage
	GN	2018	Spring	Men	631	12	0.2	6.9	2.2
	GN	2018	Winter	Dgx	625	1	23.5	214.3	10.9
	GN	2018	Winter	Dgx	631	2	119.1	696.0	17.1
	GN	2018	Winter	Shd	635	2	0.8	20.7	3.9
	GN	2019	Winter	Dgx	625	1	31.9	441.2	7.2
	GN	2019	Winter	Dgx	631	2	238.7	1289.1	18.5
	All	**All**	**All**	**All**	**All**	**48**	**632.6**	**4652.5**	**13.6**
Sooty Shearwater** (*Puffinus griseus*)	BOT	2019	Summer	Smb	526	1	13.5	155.2	8.7
	GN	2017	Fall	Dgx	521	1	60.0	513.0	11.7
	GN	2017	Fall	Ska	521	4	306.7	1741.9	17.6
	GN	2017	Summer	Dgx	521	13	93.6	1424.9	6.6
	GN	2017	Summer	Ska	521	63	155.0	2233.9	6.9
	GN	2018	Fall	Ska	521	1	110.2	1994.4	5.5
	GN	2018	Summer	Dgx	521	2	13.0	759.9	1.7
	GN	2018	Summer	Msp	513	1	10.0	166.6	6.0
	GN	2019	Fall	Msp	513	1	37.7	118.0	32.0
	GN	2019	Summer	Ska	521	1	156.4	2466.3	6.3
	SSD	2018	Summer	Sca	521	1	24.1	310.0	7.8
	All	**All**	**All**	**All**	**All**	**89**	**980.3**	**11,884.0**	**8.2**
Thin-Billed Murre (*Uria aalge*)	GN	2017	Winter	Msp	515	1	8.6	58.9	14.7
	GN	2018	Winter	Msp	513	2	67.8	197.0	34.4
	GN	2019	Spring	Msp	515	2	15.9	32.3	49.4
	GN	2019	Winter	Lob	513	7	0.1	0.1	99.7
	GN	2019	Winter	Msp	513	3	31.5	97.6	32.3
	GN	2019	Winter	Msp	514	1	11.7	10.7	100*
	All	**All**	**All**	**All**	**All**	**16**	**135.8**	**396.6**	**34.2**

*Observer effort was greater than total effort so coverage was assumed to be 100%.
**Bycatch of this species from documented baited observed gillnet data removed from this table and documented in Table 3.

Table 3. Summary of observed bycatch in documented baited gillnets for great shearwaters (GS) and sooty shearwaters (SS) from 2017-2019 by species, year, season, fishery management plan (FMP), and statistical area (Area). Percent baited bycatch of the total bycatch from the corresponding stratum (% Total Bycatch) and the percent of fishing effort from baited trips of the total observed fishing effort from the corresponding stratum (% Total Effort) are shown. Seasons were defined by calendar quarter (Winter=January-March; Spring=April-June, Summer=July-September, and Fall=October-December). FMP abbreviations are in Table 1. Effort was measured by metric tons of fish landed.

Species	Year	Season	FMP	Area	Bycatch	% Total Bycatch	% Total Effort
GS	2017	Fall	Dgx	521	31	88.57	22.64
GS	2019	Fall	Dgx	521	9	100.00	100.00
GS	2017	Summer	Dgx	521	112	95.73	20.19
GS	2017	Fall	Mnk	514	1	3.70	0.81
GS	2017	Fall	Ska	521	40	34.78	3.34
GS	2019	Fall	Ska	521	2	66.67	5.81
GS	2017	Summer	Ska	521	476	78.81	12.53
GS	2019	Summer	Ska	521	86	82.69	1.62
SS	2017	Fall	Dgx	521	1	100.00	22.64
SS	2017	Summer	Dgx	521	13	100.00	20.19
SS	2017	Fall	Ska	521	2	50.00	3.34
SS	2017	Summer	Ska	521	48	76.19	12.53
SS	2019	Summer	Ska	521	1	100.00	1.62

Table 4. Common loon (*Gavia immer*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fishery 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 1. 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
2017	MA	Gillnet	Fall	Spt	0.08	1.66	1.15
2017	MA	Gillnet	Fall	Spw	5.64	0.06	1.26
2017	MA	Gillnet	Spring	Ska	0.04	17.72	1.16
2017	MA	Gillnet	Winter	Dgx	0.02	7.92	1.15
2017	**MA**	**Gillnet**	**All**	**All**	**All**	**27.36**	**0.83**
2017	**MA**	**All**	**All**	**All**	**All**	**27.36**	**0.83**
2017	NE	Gillnet	Spring	Fsb	2.07	44.57	0.77
2017	NE	Gillnet	Spring	Ska	0.05	8.64	1.15
2017	NE	Gillnet	Summer	Fsb	1.27	42.47	0.77
2017	NE	Gillnet	Winter	Ska	0.08	9.67	1.16
2017	**NE**	**Gillnet**	**All**	**All**	**All**	**105.34**	**0.47**
2017	**NE**	**All**	**All**	**All**	**All**	**105.34**	**0.47**
2017	**All**	**All**	**All**	**All**	**All**	**132.70**	**0.41**
2018	MA	Gillnet	Fall	Spb	0.41	0.35	1.16
2018	MA	Gillnet	Spring	Dgx	0.18	2.58	1.14
2018	MA	Gillnet	Winter	Dgx	0.04	8.90	1.16
2018	**MA**	**Gillnet**	**All**	**All**	**All**	**11.83**	**0.91**
2018	**MA**	**All**	**All**	**All**	**All**	**11.83**	**0.91**
2018	NE	Gillnet	Spring	Ska	0.78	92.52	0.76
2018	NE	Gillnet	Summer	Ska	0.40	104.68	1.16
2018	**NE**	**Gillnet**	**All**	**All**	**All**	**197.20**	**0.71**
2018	NE	Sea Scallop Dredge	Winter	Sca	0.01	6.59	1.30
2018	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**6.59**	**1.30**
2018	**NE**	**All**	**All**	**All**	**All**	**203.79**	**0.69**
2018	**All**	**All**	**All**	**All**	**All**	**215.62**	**0.65**
2019	MA	Gillnet	Spring	Dgx	0.01	5.71	1.17
2019	MA	Gillnet	Winter	Dgx	0.00	5.38	1.14

Year	Region	Gear	Season	FMP	Bycatch Rate	Estimate	CV
2019	MA	Gillnet	Winter	Mnk	0.05	9.57	1.16
2019	**MA**	**Gillnet**	**All**	**All**	**All**	**20.67**	**0.69**
2019	**MA**	**All**	**All**	**All**	**All**	**20.67**	**0.69**
2019	NE	Gillnet	Fall	Dgx	0.42	0.49	1.14
2019	**NE**	**Gillnet**	**All**	**All**	**All**	**0.49**	**1.14**
2019	**NE**	**All**	**All**	**All**	**All**	**0.49**	**1.14**
2019	**All**	**All**	**All**	**All**	**All**	**21.15**	**0.68**

Table 5. Double-crested cormorant (*Phalacrocorax auritus*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fishery 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 1. 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
2017	MA	Gillnet	Fall	Cro	1.26	2.75	0.79
2017	MA	Gillnet	Fall	Spt	0.15	3.26	0.78
2017	**MA**	**Gillnet**	**All**	**All**	**All**	6.01	0.55
2017	**MA**	**All**	**All**	**All**	**All**	6.01	0.55
2017	NE	Gillnet	Summer	Ska	0.04	8.75	1.18
2017	**NE**	**Gillnet**	**All**	**All**	**All**	**8.75**	**1.18**
2017	**NE**	**All**	**All**	**All**	**All**	**8.75**	**1.18**
2017	**All**	**All**	**All**	**All**	**All**	**14.76**	**0.73**
2018	MA	Gillnet	Fall	Spb	0.79	43.08	1.20
2018	MA	Gillnet	Spring	Cro	1.02	3.05	0.78
2018	**MA**	**Gillnet**	**All**	**All**	**All**	**46.12**	**1.12**
2018	**MA**	**All**	**All**	**All**	**All**	**46.12**	**1.12**
2018	NE	Gillnet	Fall	Msp	0.12	2.61	1.19
2018	**NE**	**Gillnet**	**All**	**All**	**All**	**2.61**	**1.19**
2018	**All**	**All**	**All**	**All**	**All**	**48.73**	**1.06**
2019	MA	Bottom Otter Trawl	Fall	Fsb	0.07	5.03	1.26
2019	**MA**	**Bottom Otter Trawl**	**All**	**All**	**All**	**5.03**	**1.26**
2019	**MA**	**All**	**All**	**All**	**All**	**5.03**	**1.26**
2019	**All**	**All**	**All**	**All**	**All**	**5.03**	**1.26**

Table 6. Great black-backed gull (*Larus marinus*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fishery 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 1. 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
2017	MA	Sea Scallop Dredge	Winter	Sca	0.02	5.22	1.28
2017	**MA**	**Sea Scallop Dredge**	**All**	**All**	**All**	**5.22**	**1.28**
2017	**MA**	**All**	**All**	**All**	**All**	**5.22**	**1.28**
2017	NE	Bottom Otter Trawl	Fall	Msp	0.01	5.27	1.26
2017	NE	Bottom Otter Trawl	Summer	Smb	0.01	3.71	1.28
2017	NE	Bottom Otter Trawl	Winter	Mnk	0.03	2.40	1.24
2017	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**11.38**	**0.76**
2017	NE	Gillnet	Fall	Ska	0.00	4.73	1.29
2017	**NE**	**Gillnet**	**All**	**All**	**All**	**4.73**	**1.29**
2017	NE	Sea Scallop Dredge	Spring	Sca	0.03	10.32	1.28
2017	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**10.32**	**1.28**
2017	**NE**	**All**	**All**	**All**	**All**	**26.43**	**0.64**
2017	**All**	**All**	**All**	**All**	**All**	**31.64**	**0.58**
2018	NE	Bottom Otter Trawl	Summer	Msp	0.05	11.14	1.32
2018	NE	Bottom Otter Trawl	Winter	Msp	0.03	6.42	1.27
2018	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**17.56**	**0.96**
2018	NE	Gillnet	Spring	Mnk	0.01	6.15	1.28
2018	NE	Gillnet	Winter	Msp	0.03	5.28	0.80
2018	**NE**	**Gillnet**	**All**	**All**	**All**	**11.43**	**0.78**
2018	NE	Sea Scallop Dredge	Fall	Sca	0.05	10.83	1.30
2018	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**10.83**	**1.30**
2018	**NE**	**All**	**All**	**All**	**All**	**39.83**	**0.59**
2018	**All**	**All**	**All**	**All**	**All**	**39.83**	**0.59**
2019	NE	Bottom Otter Trawl	Fall	Msp	0.01	3.53	1.29
2019	NE	Bottom Otter Trawl	Fall	Sms	0.25	11.29	1.29
2019	NE	Bottom Otter Trawl	Summer	Smb	0.01	7.89	1.28
2019	NE	Bottom Otter Trawl	Winter	Msp	0.02	6.97	1.26

Year	Region	Gear	Season	FMP	Bycatch Rate	Estimate	CV
2019	NE	Bottom Otter Trawl	Winter	Smb	1.63	11.93	1.26
2019	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**41.60**	**0.61**
2019	NE	Gillnet	Fall	Msp	0.02	2.60	1.29
2019	NE	Gillnet	Spring	Mnk	0.17	3.01	1.27
2019	**NE**	**Gillnet**	**All**	**All**	**All**	**5.61**	**0.91**
2019	NE	Sea Scallop Dredge	Spring	Sca	0.03	23.80	0.81
2019	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**23.80**	**0.81**
2019	**NE**	**All**	**All**	**All**	**All**	**71.01**	**0.45**
2019	**All**	**All**	**All**	**All**	**All**	**71.01**	**0.45**

Table 7. Great shearwater (*Puffinus gravis*) bycatch estimates, rates of non-baited trips, and coefficient of variation (CV) by year, region, gear type, season, and fishery 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 1. 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
2017	MA	Bottom Otter Trawl	Summer	Smb	0.06	2.93	1.26
2017	**MA**	**Bottom Otter Trawl**	**All**	**All**	**All**	**2.93**	**1.26**
2017	**MA**	**All**	**All**	**All**	**All**	**2.93**	**1.26**
2017	NE	Bottom Otter Trawl	Summer	Msp	0.07	10.38	1.26
2017	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**10.38**	**1.26**
2017	NE	Gillnet	Fall	Dgx	0.22	81.87	0.29*
2017	NE	Gillnet	Fall	Mnk	0.37	83.01	0.19*
2017	NE	Gillnet	Fall	Msp	0.41	37.14	0.30
2017	NE	Gillnet	Fall	Ska	0.25	480.57	0.11*
2017	NE	Gillnet	Summer	Dgx	0.09	250.46	0.20*
2017	NE	Gillnet	Summer	Lob	3.07	4.03	1.20
2017	NE	Gillnet	Summer	Mnk	0.09	17.70	0.80
2017	NE	Gillnet	Summer	Msp	0.37	15.48	0.82
2017	NE	Gillnet	Summer	Ska	0.51	2595.40	0.07*
2017	**NE**	**Gillnet**	**All**	**All**	**All**	**3565.67**	**0.06**
2017	NE	Sea Scallop Dredge	Fall	Sca	0.03	6.95	1.27
2017	NE	Sea Scallop Dredge	Summer	Sca	0.54	208.87	0.21
2017	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**215.82**	**0.20**
2017	**NE**	**All**	**All**	**All**	**All**	**3791.87**	**0.06**
2017	**All**	**All**	**All**	**All**	**All**	**3794.80**	**0.06**
2018	NE	Gillnet	Summer	Dgx	0.33	463.09	0.36
2018	NE	Gillnet	Summer	Msp	0.47	132.26	0.36
2018	NE	Gillnet	Summer	Ska	0.09	225.44	0.46
2018	**NE**	**Gillnet**	**All**	**All**	**All**	**820.78**	**0.24**
2018	NE	Sea Scallop Dredge	Fall	Sca	0.06	65.27	0.32
2018	NE	Sea Scallop Dredge	Summer	Sca	0.18	484.53	0.15
2018	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**549.80**	**0.14**
2018	**NE**	**All**	**All**	**All**	**All**	**1370.58**	**0.16**
2018	**All**	**All**	**All**	**All**	**All**	**1370.58**	**0.16**
2019	MA	Gillnet	Summer	Ska	0.09	7.47	1.13

Year	Region	Gear	Season	FMP	Bycatch Rate	Estimate	CV
2019	**MA**	**Gillnet**	**All**	**All**	**All**	**7.47**	**1.13**
2019	**MA**	**All**	**All**	**All**	**All**	**7.47**	**1.13**
2019	NE	Bottom Otter Trawl	Fall	Msp	0.01	3.53	1.27
2019	NE	Bottom Otter Trawl	Fall	Ska	0.07	3.81	1.26
2019	NE	Bottom Otter Trawl	Summer	Smb	1.02	158.69	0.27
2019	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**166.03**	**0.26**
2019	NE	Gillnet	Fall	Dgx	10.74	62.93	0.21*
2019	NE	Gillnet	Fall	Mnk	0.04	11.34	0.81
2019	NE	Gillnet	Fall	Msp	0.55	99.91	0.18
2019	NE	Gillnet	Fall	Ska	0.01	12.20	0.95*
2019	NE	Gillnet	Summer	Dgx	0.10	88.35	0.39
2019	NE	Gillnet	Summer	Mnk	0.16	37.20	0.37
2019	NE	Gillnet	Summer	Msp	0.16	4.31	0.75
2019	NE	Gillnet	Summer	Ska	0.12	374.07	0.18*
2019	**NE**	**Gillnet**	**All**	**All**	**All**	**690.31**	**0.12**
2019	NE	Sea Scallop Dredge	Fall	Sca	0.04	9.74	1.28
2019	NE	Sea Scallop Dredge	Summer	Sca	0.01	9.32	1.29
2019	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**19.06**	**0.91**
2019	**NE**	**All**	**All**	**All**	**All**	**875.40**	**0.11**
2019	**All**	**All**	**All**	**All**	**All**	**882.87**	**0.11**

*Observed bycatch from baited gear added to final estimate.

Table 8. Herring gull (*Larus smithsonianus*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fishery 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 1. 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
2017	MA	Bottom Otter Trawl	Spring	Fsb	0.15	6.08	1.25
2017	MA	Bottom Otter Trawl	Spring	Smb	0.07	12.89	1.25
2017	MA	Bottom Otter Trawl	Winter	Smb	0.13	7.42	1.25
2017	**MA**	**Bottom Otter Trawl**	**All**	**All**	**All**	**26.38**	**0.76**
2017	MA	Sea Scallop Dredge	Winter	Sca	0.01	5.76	1.31
2017	**MA**	**Sea Scallop Dredge**	**All**	**All**	**All**	**5.76**	**1.31**
2017	**MA**	**All**	**All**	**All**	**All**	**32.15**	**0.67**
2017	NE	Bottom Otter Trawl	Fall	Msp	0.04	2.51	1.25
2017	NE	Bottom Otter Trawl	Fall	Smb	0.13	7.81	1.25
2017	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**10.32**	**1.00**
2017	NE	Sea Scallop Dredge	Spring	Sca	0.07	32.22	1.26
2017	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**32.22**	**1.26**
2017	**NE**	**All**	**All**	**All**	**All**	**42.55**	**0.98**
2017	**All**	**All**	**All**	**All**	**All**	**74.70**	**0.63**
2018	MA	Bottom Otter Trawl	Fall	Sms	0.23	4.88	1.24
2018	**MA**	**Bottom Otter Trawl**	**All**	**All**	**All**	**4.88**	**1.24**
2018	**MA**	**All**	**All**	**All**	**All**	**4.88**	**1.24**
2018	NE	Bottom Otter Trawl	Fall	Sms	0.32	12.23	1.23
2018	NE	Bottom Otter Trawl	Spring	Smb	0.23	11.85	1.24
2018	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**24.08**	**0.87**
2018	NE	Sea Scallop Dredge	Fall	Sca	0.01	5.58	1.28
2018	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**5.58**	**1.28**
2018	**NE**	**All**	**All**	**All**	**All**	**29.66**	**0.75**
2018	**All**	**All**	**All**	**All**	**All**	**34.55**	**0.67**
2019	MA	Gillnet	Summer	Sbt	0.19	8.48	1.27
2019	**MA**	**Gillnet**	**All**	**All**	**All**	**8.48**	**1.27**
2019	MA	Sea Scallop Dredge	Fall	Sca	0.10	23.12	0.81

Year	Region	Gear	Season	FMP	Bycatch Rate	Estimate	CV
2019	**MA**	**Sea Scallop Dredge**	**All**	**All**	**All**	**23.12**	**0.81**
2019	**MA**	**All**	**All**	**All**	**All**	**31.59**	**0.68**
2019	NE	Bottom Otter Trawl	Fall	Fsb	0.11	6.76	1.25
2019	NE	Bottom Otter Trawl	Summer	Msp	0.03	4.25	1.23
2019	NE	Bottom Otter Trawl	Winter	Mnk	0.13	5.72	0.79
2019	NE	Bottom Otter Trawl	Winter	Msp	0.03	6.04	1.24
2019	NE	Bottom Otter Trawl	Winter	Ska	0.15	3.99	1.24
2019	NE	Bottom Otter Trawl	Winter	Smb	1.67	12.23	1.27
2019	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**39.00**	**0.54**
2019	NE	Gillnet	Fall	Ska	0.01	8.00	1.27
2019	NE	Gillnet	Summer	Mnk	0.01	4.27	1.31
2019	NE	Gillnet	Winter	Msp	0.04	1.31	2.06
2019	**NE**	**Gillnet**	**All**	**All**	**All**	**13.57**	**0.88**
2019	NE	Sea Scallop Dredge	Fall	Sca	0.04	9.67	1.28
2019	NE	Sea Scallop Dredge	Winter	Sca	0.01	7.89	1.28
2019	**NE**	**Sea Scallop Dredge**	**All**	**All**	**All**	**17.56**	**0.91**
2019	**NE**	**All**	**All**	**All**	**All**	**70.13**	**0.41**
2019	**All**	**All**	**All**	**All**	**All**	**101.73**	**0.35**

Table 9. Northern fulmar (*Fulmarus glacialis*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fishery 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 1. 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
2017	NE	Gillnet	Fall	Msp	0.13	9.31	0.62
2017	**NE**	**Gillnet**	**All**	**All**	**All**	**9.31**	**0.62**
2017	**NE**	**All**	**All**	**All**	**All**	**9.31**	**0.62**
2017	**All**	**All**	**All**	**All**	**All**	**9.31**	**0.62**
2018	NE	Bottom Otter Trawl	Winter	Msp	0.02	3.46	1.31
2018	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**3.46**	**1.31**
2018	NE	Gillnet	Winter	Msp	0.01	2.44	1.28
2018	**NE**	**Gillnet**	**All**	**All**	**All**	**2.44**	**1.28**
2018	**NE**	**All**	**All**	**All**	**All**	**5.91**	**0.94**
2018	**All**	**All**	**All**	**All**	**All**	**5.91**	**0.94**
2019	NE	Gillnet	Fall	Msp	0.15	4.43	1.27
2019	NE	Gillnet	Winter	Msp	0.04	1.54	1.27
2019	**NE**	**Gillnet**	**All**	**All**	**All**	**5.97**	**1.00**
2019	**NE**	**All**	**All**	**All**	**All**	**5.97**	**1.00**
2019	**All**	**All**	**All**	**All**	**All**	**5.97**	**1.00**

Table 10. Northern gannet (*Morus bassanus*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fishery 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 1. 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
2017	MA	Bottom Otter Trawl	Fall	Fsb	0.08	3.72	1.23
2017	MA	Bottom Otter Trawl	Spring	Her	0.92	1.72	1.23
2017	MA	Bottom Otter Trawl	Winter	None	3.24	17.34	0.79
2017	**MA**	**Bottom Otter Trawl**	**All**	**All**	**All**	**22.77**	**0.64**
2017	**MA**	**All**	**All**	**All**	**All**	**22.77**	**0.64**
2017	NE	Bottom Otter Trawl	Winter	Mnk	0.03	2.51	1.24
2017	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**2.51**	**1.24**
2017	NE	Paired Midwater Trawl	Winter	Smb	85.76	294.96	0.14
2017	**NE**	**Paired Midwater Trawl**	**All**	**All**	**All**	**294.96**	**0.14**
2017	**NE**	**All**	**All**	**All**	**All**	**297.47**	**0.14**
2017	**All**	**All**	**All**	**All**	**All**	**320.24**	**0.13**
2018	MA	Bottom Otter Trawl	Spring	Smb	0.13	9.40	1.40
2018	**MA**	**Bottom Otter Trawl**	**All**	**All**	**All**	**9.40**	**1.40**
2018	MA	Paired Midwater Trawl	Winter	Smb	9.79	44.82	0.38
2018	**MA**	**Paired Midwater Trawl**	**All**	**All**	**All**	**44.82**	**0.38**
2018	**MA**	**All**	**All**	**All**	**All**	**54.23**	**0.40**
2018	NE	Bottom Otter Trawl	Fall	Sms	0.33	12.56	1.23
2018	NE	Bottom Otter Trawl	Winter	Sms	0.76	15.39	1.22
2018	**NE**	**Bottom Otter Trawl**	**All**	**All**	**All**	**27.95**	**0.87**
2018	NE	Gillnet	Winter	Msp	0.01	2.57	1.23
2018	**NE**	**Gillnet**	**All**	**All**	**All**	**2.57**	**1.23**
2018	**NE**	**All**	**All**	**All**	**All**	**30.52**	**0.80**
2018	**All**	**All**	**All**	**All**	**All**	**84.75**	**0.39**
2019	MA	Bottom Otter Trawl	Spring	None	0.69	0.07	1.23
2019	**MA**	**Bottom Otter Trawl**	**All**	**All**	**All**	**0.07**	**1.23**

Year	Region	Gear	Season	FMP	Bycatch Rate	Estimate	CV
2019	MA	Gillnet	Winter	Oth	0.25	15.16	1.24
2019	**MA**	**Gillnet**	**All**	**All**	**All**	**15.16**	**1.24**
2019	**MA**	**All**	**All**	**All**	**All**	**15.23**	**1.24**
2019	NE	Gillnet	Winter	Mnk	0.05	8.20	1.23
2019	NE	Gillnet	Winter	Ska	0.01	7.05	1.24
2019	**NE**	**Gillnet**	**All**	**All**	**All**	**15.25**	**0.87**
2019	**NE**	**All**	**All**	**All**	**All**	**15.25**	**0.87**
2019	**All**	**All**	**All**	**All**	**All**	**30.48**	**0.76**

Table 11. Red-throated loon (*Gavia stellata*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, baiting of gear (YES or NO), gear type, season, and fishery 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, and Gear abbreviations are the same as Table 1. Seasons are defined by calendar quarter. FMP abbreviations can be found in Table 1. 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
2017	MA	Gillnet	Spring	Dgx	0.15	108.95	0.34
2017	MA	Gillnet	Spring	Oth	0.81	33.68	0.52
2017	MA	Gillnet	Winter	Dgx	0.01	8.06	1.18
2017	MA	Gillnet	Winter	Shd	7.55	123.21	0.52
2017	**MA**	**Gillnet**	**All**	**All**		273.89	0.28
2017	**MA**	**All**	**All**	**All**		273.89	0.28
2017	**All**	**All**	**All**	**All**		273.89	0.28
2018	MA	Gillnet	Spring	Cro	1.56	4.66	0.62
2018	MA	Gillnet	Spring	Dgx	0.1	34.8	0.56
2018	MA	Gillnet	Spring	Men	64.49	442.5	0.3
2018	MA	Gillnet	Winter	Dgx	0.03	19.93	0.68
2018	MA	Gillnet	Winter	Shd	2.32	47.99	0.77
2018	**MA**	**Gillnet**	**All**	**All**		**549.88**	**0.26**
2018	**MA**	**All**	**All**	**All**		**549.88**	**0.26**
2018	**All**	**All**	**All**	**All**		**549.88**	**0.26**
2019	MA	Gillnet	Winter	Dgx	0.02	23.99	0.73
2019	**MA**	**Gillnet**	**All**	**All**		**23.99**	**0.73**
2019	**MA**	**All**	**All**	**All**		**23.99**	**0.73**
2019	**All**	**All**	**All**	**All**		**23.99**	**0.73**

Table 12. Sooty shearwater (*Puffinus griseus*) total bycatch estimates, rates of non-baited trips, and coefficient of variation (CV) by year, region, gear type, season, and fishery 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 1. 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
2017	NE	Gillnet	Fall	Dgx	NA	1.00	0.00†
2017	NE	Gillnet	Fall	Ska	0.01	12.91	0.66*
2017	NE	Gillnet	Summer	Dgx	NA	13.00	0.00 †
2017	NE	Gillnet	Summer	Ska	0.11	293.18	0.22*
2017	**NE**	**Gillnet**	**All**	**All**	**NA**	**320.09**	**0.21**
2017	**NE**	**All**	**All**	**All**	**NA**	**320.09**	**0.21**
2017	**All**	**All**	**All**	**All**	**NA**	**320.09**	**0.21**
2018	NE	Gillnet	Fall	Ska	0.01	15.48	1.26
2018	NE	Gillnet	Summer	Dgx	0.14	107.55	0.79
2018	NE	Gillnet	Summer	Msp	0.09	14.43	1.25
2018	**NE**	**Gillnet**	**All**	**All**	**NA**	**137.46**	**0.64**
2018	NE	Sea Scallop Dredge	Summer	Sca	0.04	10.92	1.27
2018	**NE**	**Sea Scallop Dredge**	**All**	**All**	**NA**	**10.92**	**1.27**
2018	**NE**	**All**	**All**	**All**	**NA**	**148.38**	**0.60**
2018	**All**	**All**	**All**	**All**	**NA**	**148.38**	**0.60**
2019	NE	Bottom Otter Trawl	Summer	Smb	0.06	9.23	1.31
2019	**NE**	**Bottom Otter Trawl**	**All**	**All**	**NA**	**9.23**	**1.31**
2019	NE	Gillnet	Fall	Msp	0.02	2.70	1.25
2019	NE	Gillnet	Summer	Ska	N/A	1.00	0.00 †
2019	**NE**	**Gillnet**	**All**	**All**	**NA**	**3.70**	**1.25**
2019	**NE**	**All**	**All**	**All**	**NA**	**12.94**	**1.05**
2019	**All**	**All**	**All**	**All**	**NA**	**12.94**	**1.05**

*Observed bycatch from baited gear added to final estimate.
†Only bycatch from baited gear observed in this strata.

Table 13. Thin-billed murres (*Uria aalge*) bycatch estimates, rates, and coefficient of variation (CV) by year, region, gear type, season, and fishery 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 1. 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
2017	NE	Gillnet	Winter	Msp	0.10	5.89	1.25
2017	**NE**	**Gillnet**	**All**	**All**	**All**	**5.89**	**1.25**
2017	**NE**	**All**	**All**	**All**	**All**	**5.89**	**1.25**
2017	**All**	**All**	**All**	**All**	**All**	**5.89**	**1.25**
2018	NE	Gillnet	Winter	Msp	0.03	5.37	0.81
2018	**NE**	**Gillnet**	**All**	**All**	**All**	**5.37**	**0.81**
2018	**NE**	**All**	**All**	**All**	**All**	**5.37**	**0.81**
2018	**All**	**All**	**All**	**All**	**All**	**5.37**	**0.81**
2019	NE	Gillnet	Spring	Msp	0.12	3.74	0.79
2019	NE	Gillnet	Winter	Lob	47.19	5.95	0.40
2019	NE	Gillnet	Winter	Msp	0.08	2.95	2.02
2019	**NE**	**Gillnet**	**All**	**All**	**All**	**12.64**	**0.56**
2019	**NE**	**All**	**All**	**All**	**All**	**12.64**	**0.56**
2019	**All**	**All**	**All**	**All**	**All**	**12.64**	**0.56**

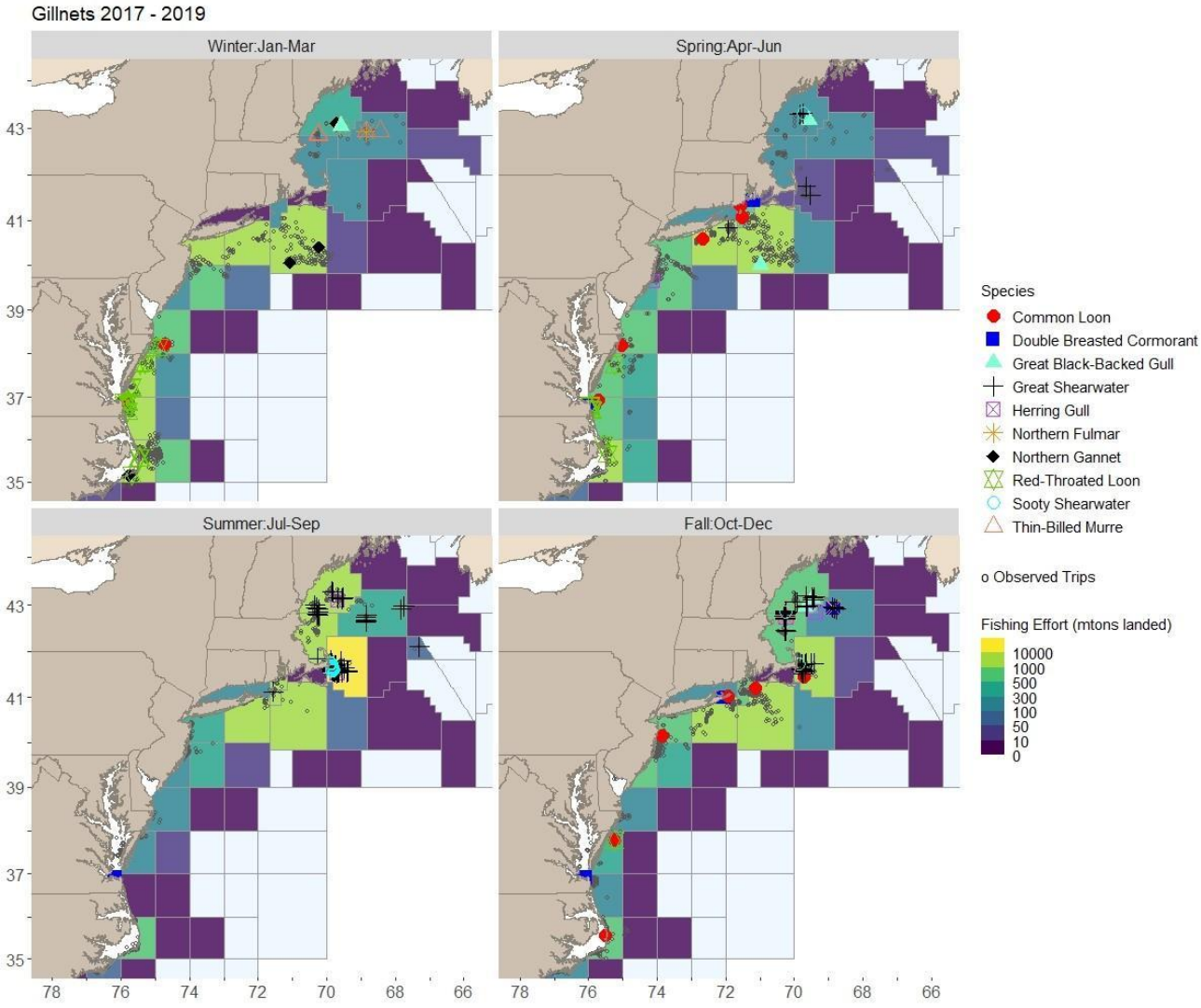

Figure 1. Map of total fishing effort, observed fishing trips, and observed bycatch of seabirds for gillnet fisheries off the Northeast and Mid-Atlantic coasts of the U.S. from 2017-2019.

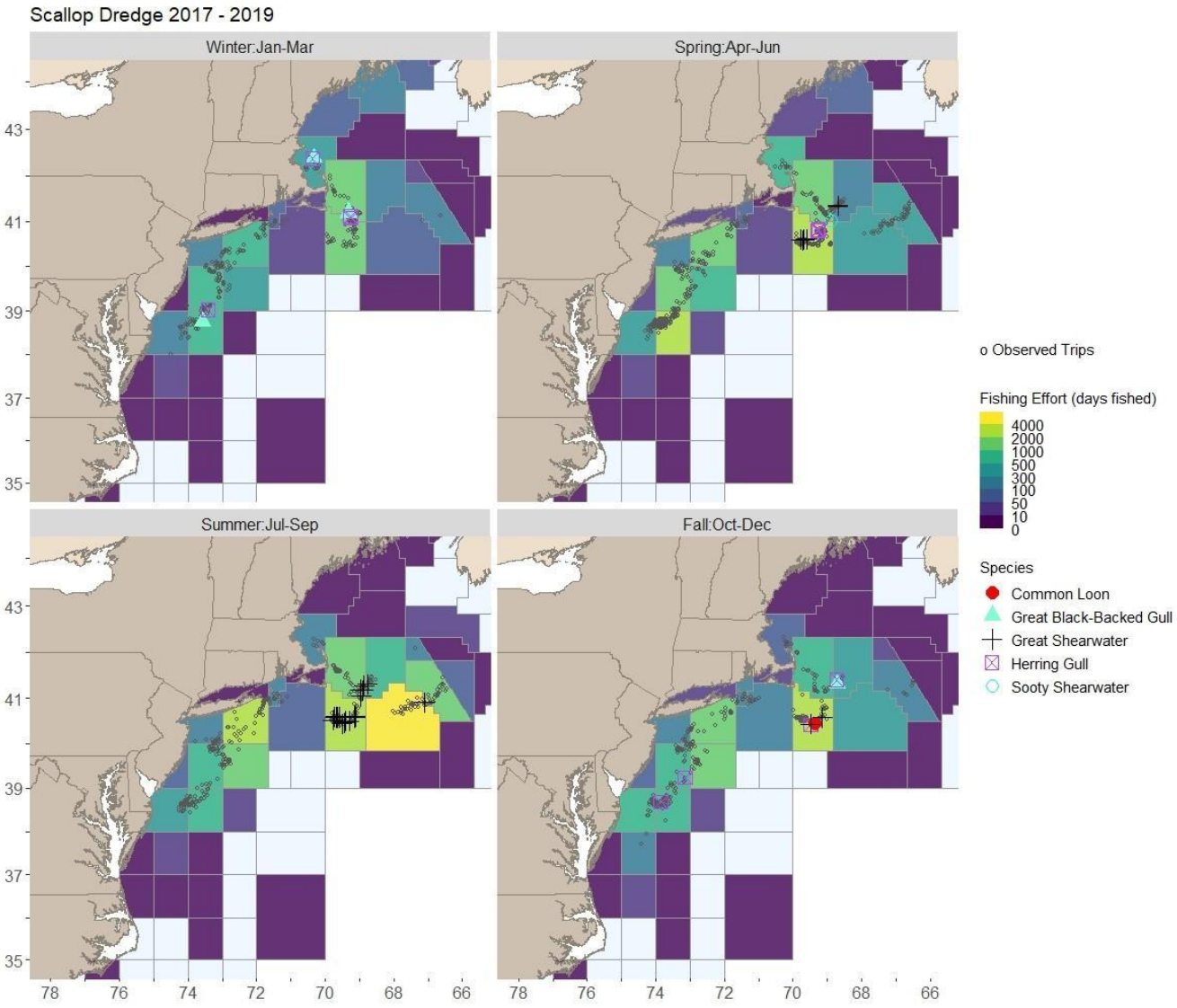

Figure 2. Map of total fishing effort, observed fishing trips, and observed bycatch of seabirds for the sea scallop dredge fishery off the Northeast and Mid-Atlantic coasts of the U.S. from 2017-2019.

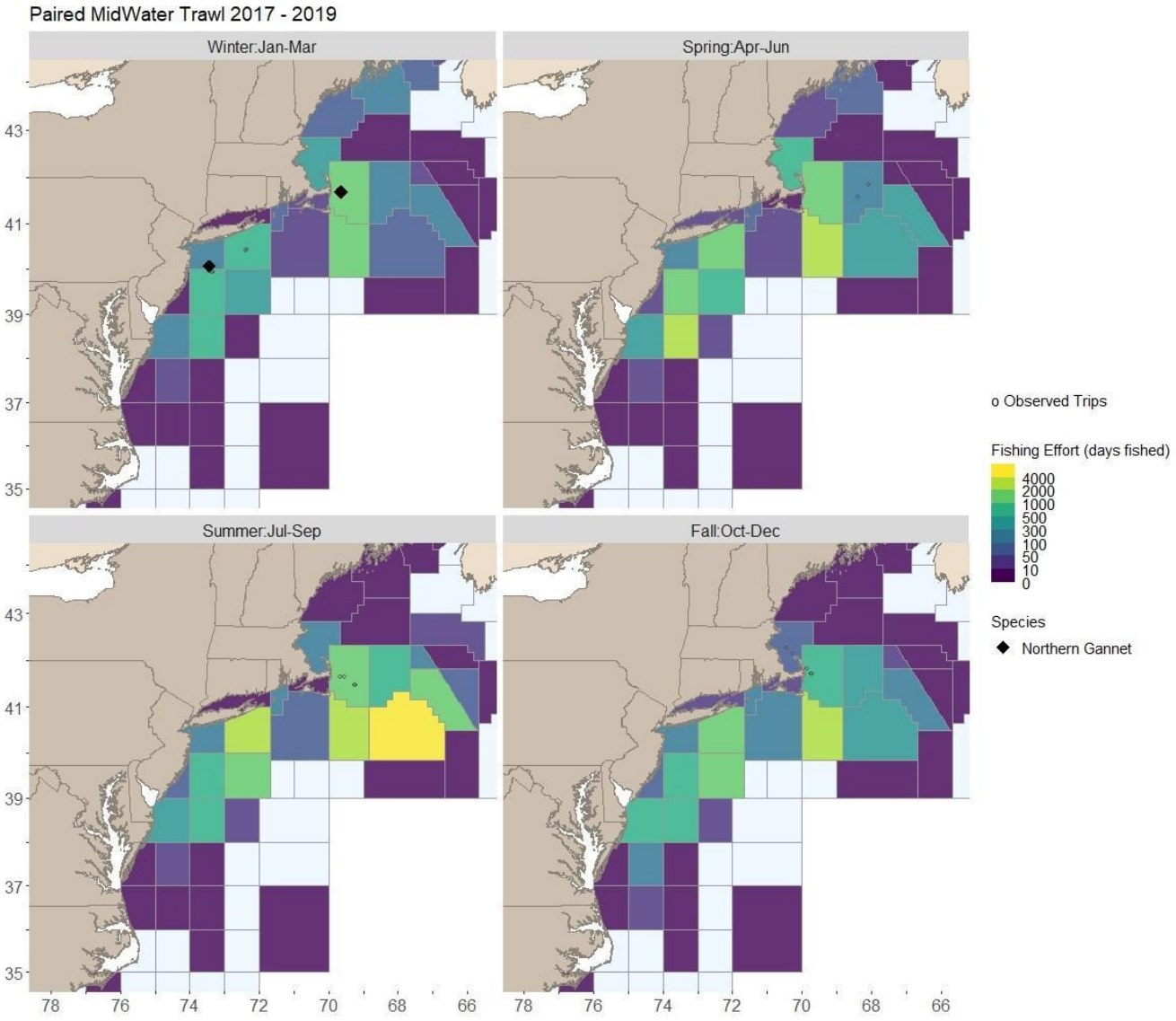

Figure 3. Map of total fishing effort, observed fishing trips, and observed bycatch of seabirds for paired midwater trawl fisheries off the Northeast and Mid-Atlantic coasts of the U.S. from 2017-2019.

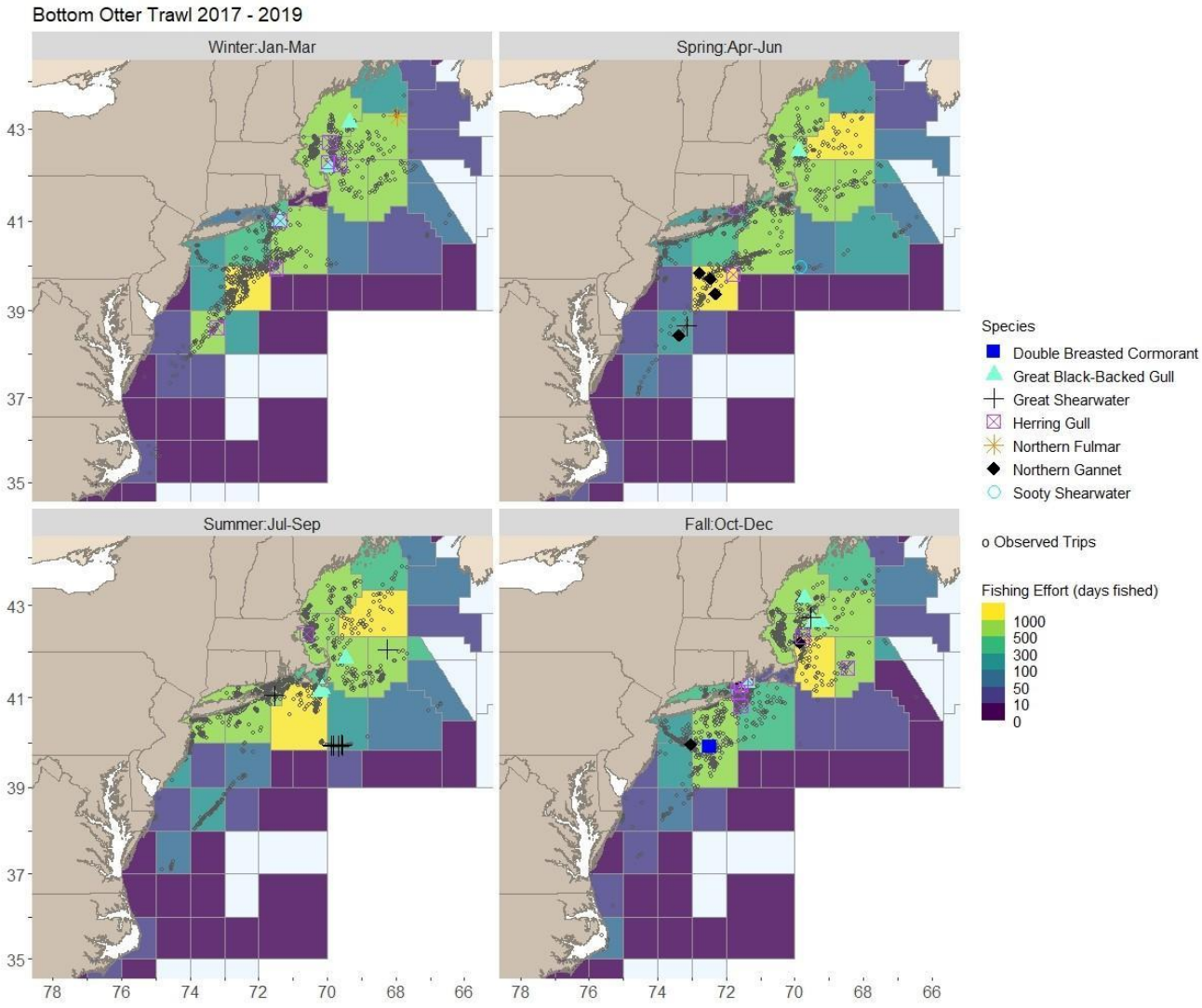

Figure 4. Map of total fishing effort, observed fishing trips, and observed bycatch of seabirds for bottom otter trawl fisheries off the Northeast and Mid-Atlantic coasts of the U.S. from 2017-2019.

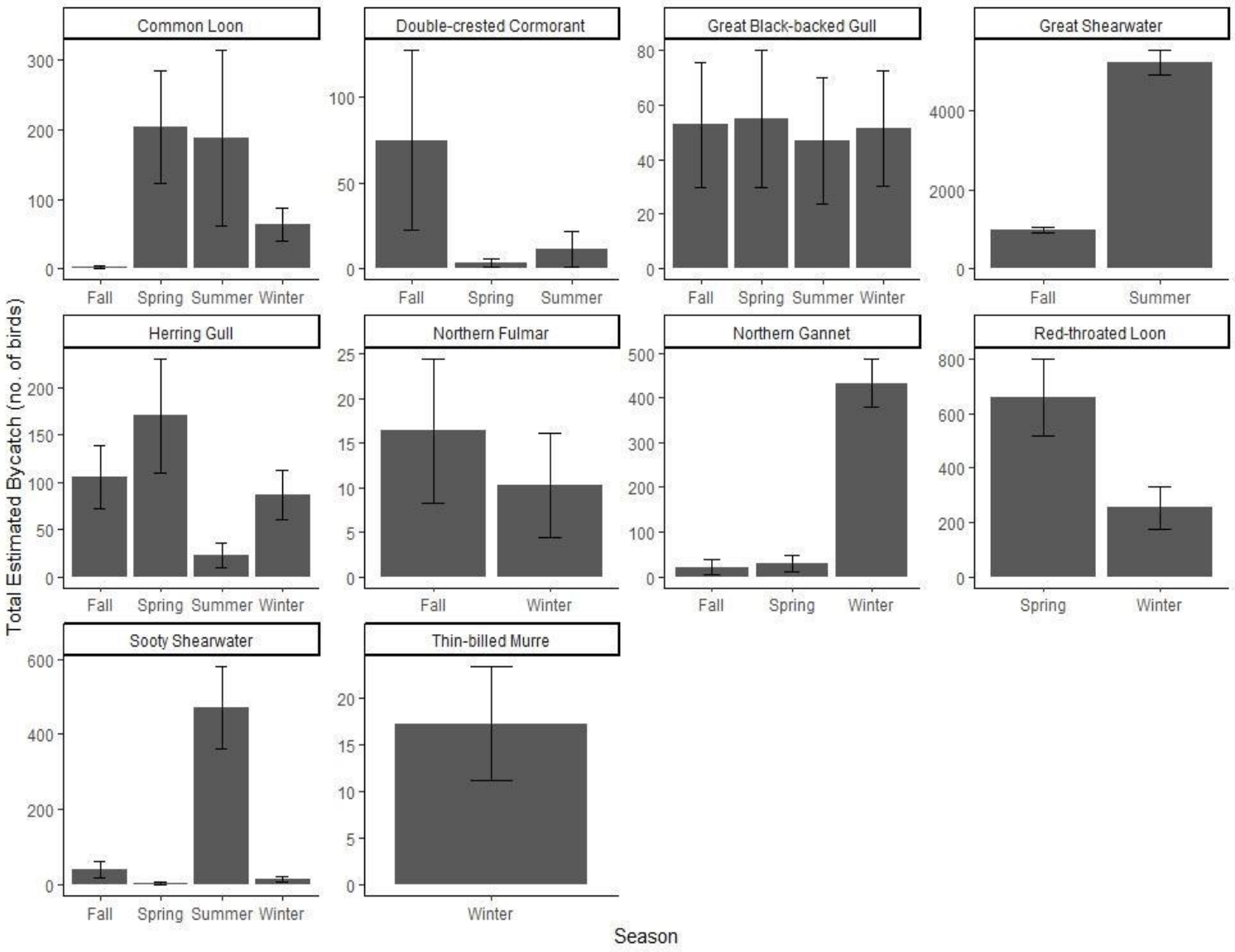

Figure 5. Seasonal estimates of seabird bycatch by species for the years 2017-2019 combined.

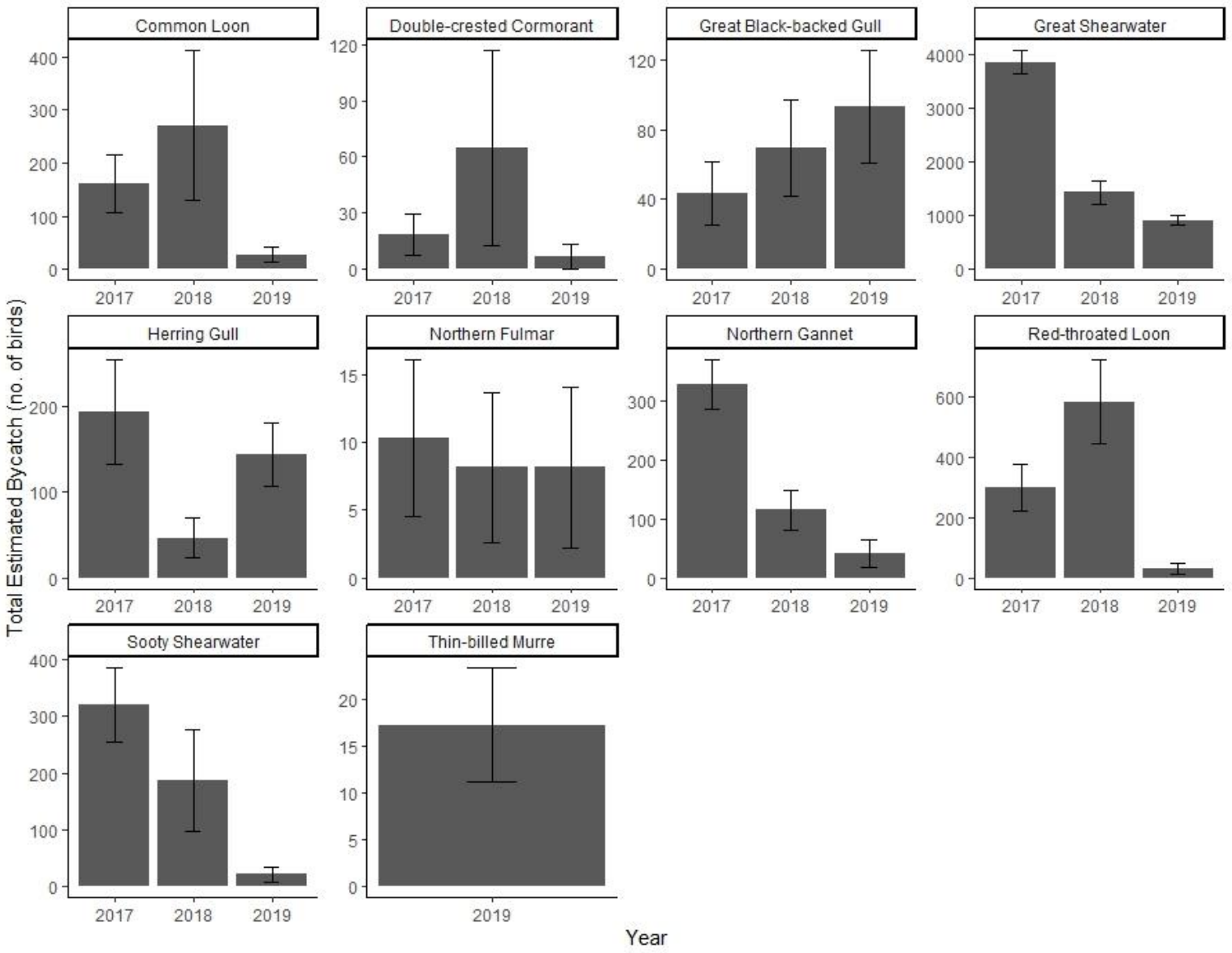

Figure 6. Annual estimates of seabird bycatch by species from 2017-2019.

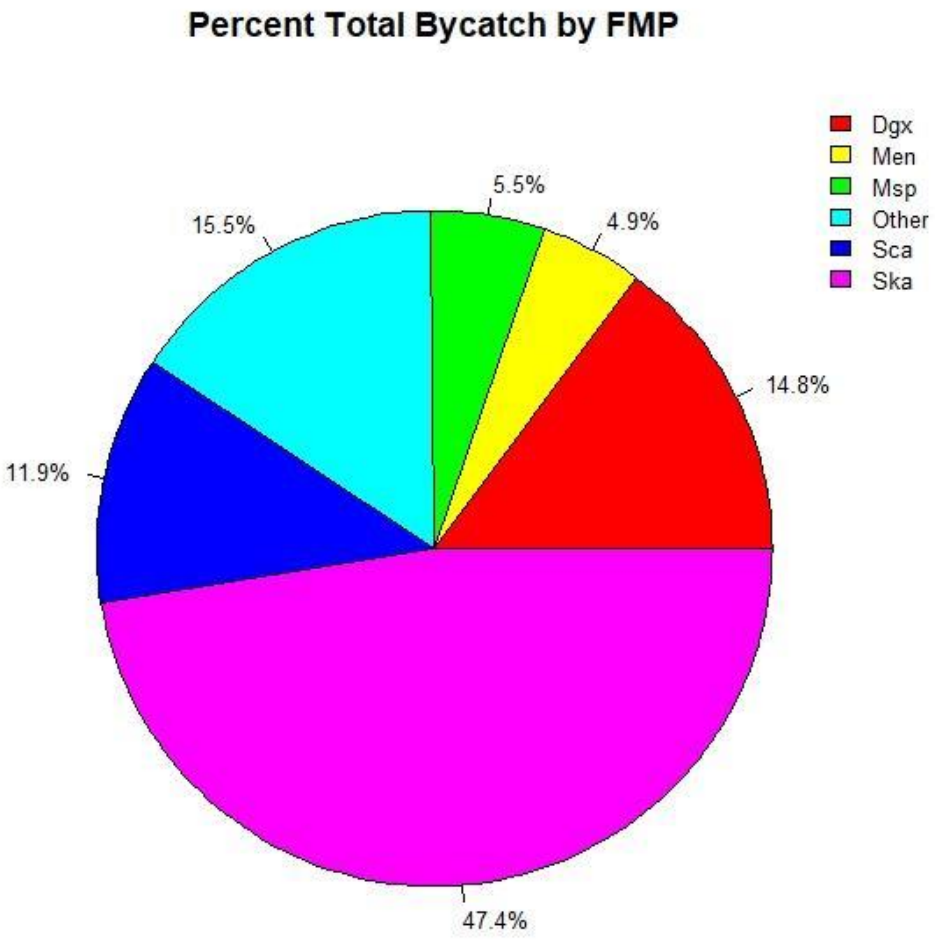

Figure 7. Percentage of total seabird bycatch from 2017-2019 by fishery management plan (FMP) for all species and years combined. Definitions for FMPs can be found in Table 1.

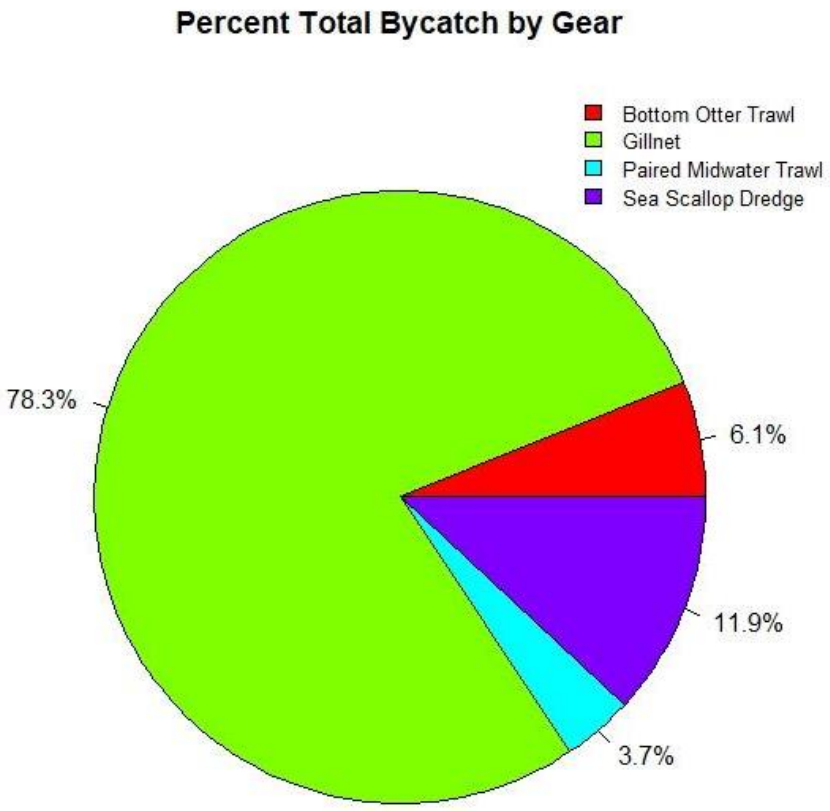

Figure 8. Percentage of total seabird bycatch from 2017-2019 by gear type for all species and years combined.

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