GRAY SEAL (*Halichoerus grypus atlantica*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal (*Halichoerus grypus*) is found on both sides of the North Atlantic, with three major populations: Northeast Atlantic, Northwest Atlantic, and the Baltic Sea (Haug et al. 2007). The Northeast Atlantic and the Northwest Atlantic populations are classified as the subspecies *H. g. atlantica* (Olsen et al. 2016). The Northwest Atlantic population defines the western North Atlantic stock which represents a transboundary stock ranging from New Jersey to Labrador (Davies 1957; Mansfield 1966; Katona et al. 1993; Lesage and Hammill 2001). This stock is separated from the northeastern Atlantic stocks by geography, differences in the breeding season, and mitochondrial and nuclear DNA variation (Bonner 1981; Boskovic et al. 1996; Lesage and Hammill 2001; Klimova et al. 2014). In the Canadian portion of its range, the Northwest population contains two breeding aggregations: Scotian Shelf (Sable Island and coastal Nova Scotia) and Gulf of St. Lawrence (DFO 2022). Outside of the breeding season, animals from these two breeding aggregations mix with a third breeding aggregation of animals breeding in U.S. waters (Lavigueur and Hammill 1993; Harvey et al. 2008; Breed et al. 2006, 2009), and all three breeding aggregations are considered a single population based on genetic similarity (Boskovic et al. 1996; Wood et al. 2011). The population has been described as a metapopulation with a mainland-island structure, due to the size of the breeding colony on Sable Island in relation to other colonies and the movement of animals between them (den Heyer et al. 2020).

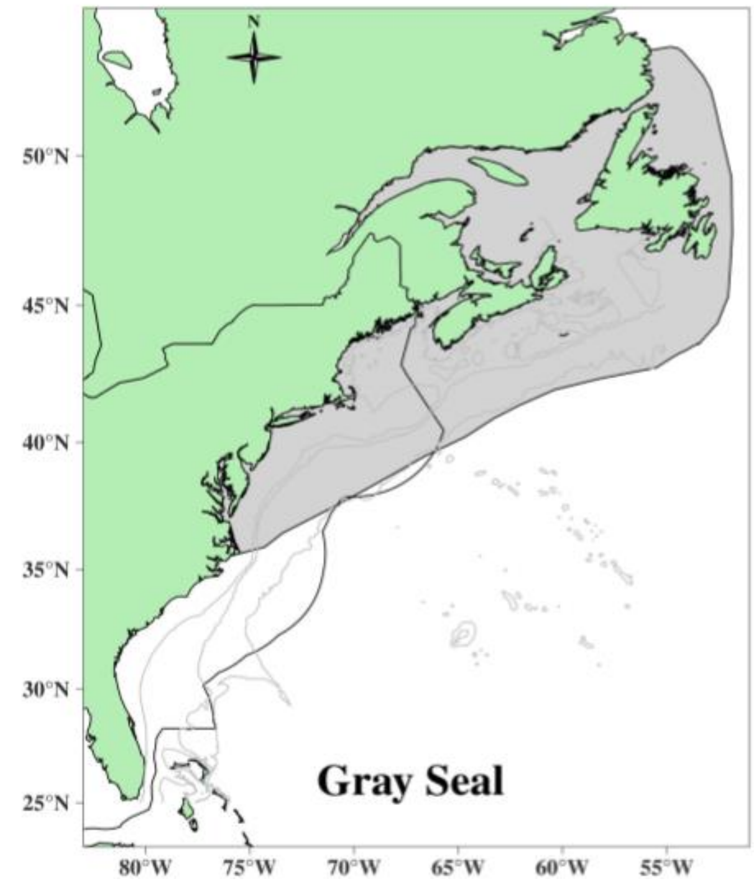

Figure 1. Approximate range of the Western North Atlantic stock of gray seals (**Halichoerus grypus atlantica*****).***

After near extirpation due to bounties, which ended in the 1960s, small numbers of animals and pups were observed on several isolated islands along the Maine coast and in Nantucket Sound, Massachusetts (Katona et al. 1993; Rough 1995; Gilbert et al. 2005). In December 2001, NMFS initiated aerial surveys to monitor gray seal pup production on Muskeget Island and adjacent sites in Nantucket Sound, and Green and Seal Islands off the coast of Maine (Wood et al. 2007). Tissue samples collected from Canadian and U.S. populations were examined for genetic variation using mitochondrial and nuclear DNA (Wood et al. 2011). All individuals were identified as belonging to one population, confirming the new U.S. population was recolonized by Canadian gray seals. The genetic evidence (Boskovic et al. 1996; Wood et al. 2011) provides a high degree of certainty that the western North Atlantic stock of gray seals comprise a single metapopulation. Further supporting evidence comes from sightings of seals in the U.S. that had been branded on Sable Island, resights of tagged animals, and satellite tracks of tagged animals (Nowak et al. 2020; Murray et al. 2021). The amount of mixing and percentage of time that individuals use U.S. and Canadian waters is unknown.

POPULATION SIZE

Currently there is a lack of information on the rate of exchange between animals in the U.S. and Canada, which may influence seasonal changes in abundance throughout the range of this transboundary species as well as life history parameters in population models. As a result, the size of the Northwest Atlantic gray seal population is estimated separately for the portion of the population in Canada versus the U.S., and mainly reflects the size of the breeding population in each respective country (Table 1). Total pup production in 2021 at breeding colonies in Canada was estimated to be 98,200 pups (95% CI = 86,800 - 109,700; DFO 2022). Production at Gulf of St. Lawrence, and Scotian Shelf colonies accounted for 17%, and 83%, respectively, of the estimated total number of pups born. Population models, incorporating estimates of age-specific reproductive rates and removals, are fit to these pup production estimates to estimate total population levels in Canada. The total Canadian gray seal population in 2021 was estimated to be 366,400 (95% CI=317,800 to 409,400; DFO 2022). Uncertainties in the population estimate derive from uncertainties in life history parameters such as mortality rates and sex ratios (DFO 2022).

In U.S. waters, the number of pupping sites has increased from 1 in 1988 to 109 in 2021 and are located in Maine and Massachusetts (Wood et al. 20222020). Although white-coated pups have stranded on eastern Long Island beaches in New York, no pupping colonies have been detected in that region. An estimated 6,663 pups were born in 2021 at U.S. breeding colonies (Wood et al. 2022), approximately 6% of the total pup production over the entire range of the population (DFO 2022). Muskeget Island is the largest pupping colony in the U.S. and the third largest of all colonies across the U.S. and Canada (den Heyer et al. 2020). Mean rates of increase in the minimum number of pups born at various times since 1988 at 4 of the more frequently surveyed pupping sites (Muskeget, Monomoy, Seal, and Nomans Islands) ranged from 11.5% (95%CI: 3.7–19.2%) to 44.1% (95% CI: 28.1–60.2%; Wood et al. 2022). These high rates of increase provide further support that seals are recruiting to some U.S. colonies at various times from larger established breeding colonies in Canada.

The number of pups born at U.S. breeding colonies can be used to approximate the total size (pups and adults) of the gray seal population in U.S. waters, based on the ratio of total population size to pups in Canadian waters (4.19:1, based on the ratio of total population to pups in the Canadian portion of the stock in 2016) (Wood et al. 2022). Although not yet measured for U.S. waters, this ratio falls within the range of other adult to pup ratios suggested for pinniped populations (Harwood and Prime 1978; Thomas et al. 2019). A simple multiplier is used to estimate population size because vital rates (age-specific reproductive rates, survival) necessary for fitting age-structured population models to pup counts are not available for the portion of the population in U.S. waters. The multiplier used assumes the vital rates in Canadian waters are the same as in the U.S.. Using this approach, the population estimate during the pupping season in U.S. waters is 27,911 . There is no coefficient of variation (CV) around the expansion factor, and likewise, the population estimate resulting from the application of the correction factor to the number of pups born. . There is further uncertainty in this abundance level in the U.S. because life history parameters that influence the ratio of pups to total individuals in this portion of the population are unknown. It also does not reflect seasonal changes in stock abundance in the Northeast region for a transboundary stock. For example, roughly 24,000 seals were observed in southeastern Massachusetts alone in 2015 (Pace et al. 2019), yet 28,000–40,000 gray seals were estimated to be in this region in 2015 using correction factors applied to seal counts obtained from Google Earth imagery (Moxley et al. 2017).

Table 1. Summary of recent abundance estimates for the western North Atlantic gray seal (*Halichoerus grypus atlantica*) by year, and area covered, resulting total abundance estimate and 95% confidence interval.

Year	Area	N_{est} [a]	CI
2016[b]	Gulf of St Lawrence + Nova Scotia Eastern Shore + Sable Island	424,300	263,600–578,300
2016	U.S.	27,300[c]	NA
2021[d]	Gulf of St Lawrence + Scotian Shelf	366,400	317,800 - 409,400
2021[e]	U.S.	27,911[d]	NA

a. These are model-based estimates derived from pup surveys.
b. DFO 2017
c. This is derived from total population size to pup ratios in Canada, applied to U.S. pup counts.
d. DFO 2022
e. Wood et al. 2022

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20^{th} percentile of the log-normal distribution as specified by Wade and Angliss (1997). When the variance around the expansion factor is unknown, a default CV of 0.20 is recommended for calculating a minimum population estimate rather than assuming zero variance in the correction factor (Wade and Angliss 1997), and was used to calculate Nmin for the U.S. Based on an estimated U.S. population in 2021 of 27,911 , the minimum population estimate in U.S. waters is 23,624 and 359,332 in Canada, for a total Nmin of 376,621 (Table 2). Similar to the best abundance estimate, there is uncertainty in this minimum abundance level in the U.S. because life history parameters that influence the ratio of pups to total individuals in this population are unknown. Furthermore, the U.S.minimum population estimate reflects a portion of the stock's range and may vary seasonally as some portion of the larger stock moves in and out of U.S. waters.

Current Population Trend

In the U.S., the estimated mean rate of increase in the minimum number of pups born was 20.9% on Muskeget Island from 1988–2021, 19.9% on Monomoy Island from 2009–2021, 44.1% on Nomans Island from 2011–2021, and 11.5% on Seal Island from 2000–2021 (Wood et al. 2022). These increases only reflect increases in pupping and as such are not an accurate or precise measure of total population growth. The latter is also influenced by juvenile and adult survival, as well by immigration from Canadian waters.

The total population of gray seals in Canada was estimated to be increasing by 4.4% per year from 1960–2016 (Hammill et al. 2017), primarily due to increases at Sable Island. Pup production on Sable Island increased exponentially at a rate of 12.8% per year between the 1970s and 1997 (Bowen et al. 2003). The 2021 survey marked the first time in 60 years that the estimate of pup production had decreased on Sable Island, though total pup production in the Gulf and Scotian Shelf was not significantly different than in 2016 (den Heyer et al. 2022). Pupping also occurs on Hay Island off Nova Scotia, in colonies off southwestern Nova Scotia, and in the Gulf of St. Lawrence. Since 1997, the rate of increase has slowed (Bowen et al. 2011; den Heyer et al. 2017), supporting the hypothesis that density-dependent changes in vital rates may be limiting population growth. Based on the most recent assessment of animals in Canada, the population increased at a rate of 1.5% per year between 2016 and 2021 (DFO 2022) .

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.128, based on historic rates of increase observed on Sable Island (Bowen et al. 2003).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). An adjusted PBR is reported for managing gray seals in U.S. waters (NMFS 2023) because information on fisheries mortality in Canada is unknown (DFO 2022), and some portion of the Canadian animals likely never enters U.S. waters (O'Boyle and Sinclair 2012). The adjusted PBR is based on the portion of the minimum total stock size estimated to be in U.S. waters (Table 2). The minimum population size for the portion of the stock residing in U.S. waters is 23,624. The maximum productivity rate is 0.128. The recovery factor (Fr) for this stock is 1.0, the value for stocks of unknown status, but which are known to be increasing. PBR for the portion of the western North Atlantic stock of gray seals residing in U.S. waters is 1,512 animals (Table 2). Uncertainty in the PBR level arises from uncertainty in seasonal changes in gray seal abundance in U.S. waters, and rates of exchange between animals in Canada and the U.S.

Table 2. Best and minimum abundance estimates for the western North Atlantic gray seal (**Halichoerus grypus atlantica*****) with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) and a stock-wide and U.S. apportioned PBR.***

Area	N_{est}	CV	N_{min}	F_r	R_{max}	PBR
U.S.	27,911	0.20 (default)	23,624			1,512
Canada	366,400	0.06	349,332			22,592
Total	394,311	0.05	376,621	1	0.128	24,104

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2017–2021, the average annual estimated human-caused mortality and serious injury to gray seals in the U.S. was 1,388 and for Canada was 3,182, not including the unknown mortality from commercial fisheries, resulting in a total minimum estimate of 4,570 per year. Mortality in U.S. fisheries is explained in further detail below.

Table 3. The total annual estimated average human-caused mortality and serious injury for the western North Atlantic gray seal (**Halichoerus grypus atlantica*****).***

Years	Source	Annual Est. Avg.
2017–2021	U.S. commercial fisheries using observer data	1,348
2017–2021	U.S. commercial fisheries using stranding data (serious injuries)	24 (minimum count)
2017–2021	U.S. non-fishery human-caused stranding mortalities and serious injuries	14
2017–2021	U.S. research mortalities	2.0
	U.S. Total	1,388
2017–2021	Canadian commercial harvest	1018
2017–2021	DFO Canada scientific collections	84
2017–2021	Canadian removals of nuisance animals	2080
2017–2021	Canadian commercial fisheries bycatch	Unknown
U.S. and Canadian TOTAL		4,570

Some human-caused mortality or serious injury may not be able to be quantified. Observed serious injury rates are lower than would be expected from the anecdotally observed numbers of gray seals living with ongoing entanglements. Estimated rates of entanglement in gillnet gear, for example, may be biased low because 100% of observed animals are dead when they come aboard the vessel (Josephson 2023); therefore, rates do not reflect the number of live animals that may have broken free of the gear, but remain entangled. Counts of live animals living with entanglements can be informed by strandings data or research studies. For example, at least 24 live seals were observed entangled in monofilament net on Cape Cod in a study where mean prevalence of live entangled gray seals ranged from roughly 1 to 4% at haul-out sites in Massachusetts and Isles of Shoals (Iruzun Martins et al. 2019) (Table 6). Incomplete information on the true number of seals living with serious injuries from entanglements increases the amount of uncertainty in the estimated fisheries-related mortality.

Fishery Information

Detailed fishery information is given in Appendix III.

United States

Northeast Sink Gillnet

Annual mortalities were estimated using annual stratified ratio-estimator methods *(*Orphanides 2020, 2021; Precoda and Orphanides 2022; Precoda 2023). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Northeast Bottom Trawl

Annual mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos and Chavez-Rosales 2022). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Mid-Atlantic Bottom Trawl

Annual mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos and Chavez-Rosales 2022). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Mid-Atlantic Gillnet

Annual mortalities were estimated using annual stratified ratio-estimator methods (Orphanides 2020, 2021; Precoda and Orphanides 2022; Precoda 2023). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

Gulf of Maine Atlantic Herring Purse Seine Fishery

No mortalities have been observed in this fishery, during the current 5-year period, however, 1 gray seal was captured and released alive in 2018 (Josephson 2023).

Northeast Mid-Water and Pair Trawl

Only 1 gray seal was observed in these fisheries from 2017–2021 and an expanded bycatch estimate has not been generated. See Table 4 for observed mortality and serious injury for during the current 5-year period, and Appendix V for historical bycatch information.

Table 4. Summary of the incidental mortality and serious injury of gray seals (**Halichoerus grypus atlantica*****) by U.S. commercial fishery including the years sampled, the type of data used (Data Type), the annual observer coverage (Observer Coverage), mortalityrecorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).***

Fishery	Years	Data Type[a]	Observer Coverage[b]	Observed Serious Injury[c]	Observed Mortality	Est. Serious Injury	Est. Mortality	Est. Comb. Mortality	Est. CVs	Mean Annual Combined Est. Mortality
Northeast Sink Gillnet	2017 2018 2019 2020 2021	Obs. Data, Weighout, Trip Logbook	0.12 0.11 0.13 0.02 0.11	0 0 0 0 0	158 103 251 14 48	0 0 0 0 0	930 1113 2019 1357 1027	930 1113 2014 1357 1027	0.16 0.32 0.17 0.14 0.14	1,289 (0.13)
Mid-Atlantic Gillnet	2017 2018 2019 2020 2021	Obs. Data, Trip Logbook, Allocated Dealer Data	0.09 0.09 0.013 0.03 0.01	0 0 0 0 0	0 0 3 0 0	0 0 0 0 0	0 0 18 9 7	0 0 18 9 7	0 0 0.40 0.72 0.69	7(1.07)
Northeast Bottom Trawl[c,d]	2017 2018 2019 2020 2021	Obs. Data, Trip Logbook	0.12 0.12 0.16 0.08 0.19	0 0 0 0 0	2 5 6 7 2	0 0 0 0 0	16 32 30 26 7.5	16 32 30 26 7.5	0.24 0.42 0.37 0.26 0.60	22 (0.18)

Fishery	Years	Data Type[a]	Observer Coverage[b]	Observed Serious Injury[c]	Observed Mortality	Est. Serious Injury	Est. Mortality	Est. Comb. Mortality	Est. CVs	Mean Annual Combined Est. Mortality
Mid-Atlantic Bottom Trawl	2017 2018 2019 2020 2021	Obs. Data, Trip Logbook	0.14 0.12 0.12 0.02 0.04	0 0 0 0 0	5 7 3 1 0	0 0 0 0 0	26 56 22 35 0	26 56 22 35 0	0.40 0.58 0.53 0.35 0	28 (0.27)
Northeast Mid-water Trawl – Incl.Pair Trawl	2017 2018 2019 2020 2021	Obs. Data, Trip Logbook	0.16 0.14 0.28 0.13 0.36	0 0 0 0 0	0 1 0 0 1	0 0 0 0 0	0 na 0 0 0	0 na 0 0 0	0 na 0 0 0	0.2 (na)[d]
TOTAL										1348 (0.12)

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast multispecies sink gillnet fishery.
b. The observer coverages for the northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed. North Atlantic bottom trawl, mid-Atlantic bottom trawl, and mid-Atlantic mid-water trawl fishery coverages are ratios based on trips. Total observer coverage reported for bottom trawl gear and gillnet gear includes traditional fisheries observers in addition to fishery monitors through the Northeast Fisheries Observer Program (NEFOP).
c. Serious injuries were evaluated for the 2017–2020 period (Josephson et al. 2023). Due to the impact of the COVID-19 pandemic on observer coverage, a 3-year average (2017–2019) was used to estimate mortality and serious injury for the calendar year 2020. The observed numbers are included in the usual columns for the sake of documentation only.
d. No estimate made. Raw counts provided. Fishery related bycatch rates for 2017–2021 were estimated using an annual stratified ratio-estimator following the methodology described in Chavez-Rosales et al. (2018).

Research Takes

From 2017–2021 there were 2 gray seal mortalities which occurred incidental to research activities under MMPA/ESA permits: 1 in 2017 and 1 in 2020. No gray seal mortalities or serious injuries were reported during this period through the Protected Species Incidental Take database, which covers incidentally captured protected species in NMFS fisheries research surveys including those funded and directed by NMFS and includes partner surveys.

Canada

There is limited information on Canadian fishery bycatch (DFO 2017). Historically, an unknown number of gray seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets; Atlantic Canada and Greenland salmon gillnets; Atlantic Canada cod traps, and Bay of Fundy herring weirs (Read 1994). The lack of information on bycatch in Canada increases the uncertainty in the total level of fishery mortality impacting this transboundary stock.

STATUS OF STOCK

Gray seals are not listed as threatened or endangered under the Endangered Species Act, and the western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. The average annual human-caused mortality and serious injury during 2017–2021 in U.S. waters does not exceed the PBR of the U.S. portion of the stocks. The status of the gray seal population relative to Optimum Sustainable Population (OSP) in U.S. Atlantic EEZ waters is unknown, but the stock's abundance appears to be increasing in Canadian and U.S. waters Total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR for U.S. waters and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate.

Uncertainties in the rates of exchange and levels of mixing between animals using U.S. and Canadian waters, as well as fishery related mortality in both the U.S. and Canada, could have an effect on the designation of the status of this stock in U.S. waters.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Strandings

United States

Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960s (Katona et al. 1993; Lelli et al. 2009). This hunt may have severely depleted this stock in U.S. waters (Rough 1995; Lelli et al. 2009). Other sources of mortalities caused by human interactions include boat strikes, power plant entrainment, oil spill/exposure, harassment, and shooting. Table 5 presents summaries of gray seal strandings as reported to the NOAA National Marine Mammal Health and Stranding Response Database (accessed 15 October2022). Most stranding mortalities were in Massachusetts, which is the center of gray seal abundance in U.S. waters. Stranding data are effort-dependent and opportunistic, and represent only a fraction of both natural and anthropogenic mortality. In an analysis of mortality causes of stranded marine mammals on Cape Cod and southeastern Massachusetts between 2000 and 2006, Bogomolni et al. (2010) reported that 45% of gray seal stranding mortalities were attributed to human interaction. Stranding mortalities that are attributed to fishery interactions overlap with the modeled analysis of fishery bycatch based on NMFS observer coverage and so, while included in Table 5 below and summarized in Table 6, are not added to the total annual estimated human-caused mortality presented in Table 3.

In addition to stranding mortalities, there are live stranded animals with serious injuries from human interaction. Table 6 presents a summary of these live animals as reported to the NOAA National Marine Mammal Health and Stranding Response Database (accessed 09 September 2023) A serious injury is defined as an injury that has a >50% chance of resulting in a mortality (NMFS 2023), and includes animals with characteristics such as gear constrictions or with the potential to constrict, ingested gear or hooks, and visible fractures. Data on animals living with serious injuries are effort dependent and opportunistic, and may or may not be attributable to a source. Counts of serious injuries currently represent a minimum and may also include repeat sightings of the same individual; these counts could be improved, and potentially expanded from estimated entanglement rates, with systematic surveys, standardized reporting, and a system to uniquely identify individual seals.

An Unusual Mortality Event (UME) was declared in July 2018 due to increased numbers of harbor and gray seal strandings along the U.S. coasts of Maine, New Hampshire, and Massachusetts. From July 1, 2018 to March 13, 2020, over 3,000 seals (including harbor and gray seals) stranded from Maine to Virginia. The preliminary cause of the UME was attributed to a phocine distemper outbreak (https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/2018-2020-pinniped-unusual-mortality-event-along).

Table 5. Gray seal (**Halichoerus grypus atlantica*****) stranding mortalities along the U.S. Atlantic coast (2017-2021) with subtotals of animals recorded as pups in parentheses.***

State	2017	2018	2019	2020	2021	Total
Maine	14 (1)	25 (0)	15 (0)	24 (2)	12 (3)	90(6)
New Hampshire	3 (0)	9 (3)	5 (0)	5 (0)	3 (1)	25 (4)
Massachusetts	135 (21)	261 (29)	260 (80)	199 (25)	164 (16)	1019 (171)
Rhode Island	16 (5)	20 (3)	28 (8)	19 (0)	3 (2)	86 (18)
Connecticut	3 (0)	1 (0)	0	1 (0)	0	5 (0)
New York	16 (0)	25 (1)	43 (4)	30 (4)	3 (1)	117(10)
New Jersey	4 (3)	14 (10)	9 (8)	5 (4)	3 (3)	30(24)
Delaware	1 (0)	4 (2)	2 (1)	1 (0)	2 (1)	10 (4)
Maryland	0	1 (1)	0	0	0	1 (1)
Virginia	0	1 (1)	0	0	1 (0)	2(1)
North Carolina	0	5 (2)	0	1 (0)	0	6(2)

State	2017	2018	2019	2020	2021	Total
Total	233 (30)	366 (52)	362 (101)	285 (35)	191 (27)	1396(245)
Unspecified seals (all states)	86	92	80	45	31	334

Table 6. Documented gray seal (**Halichoerus grypus atlantica*****) human-interaction related stranding mortalities and serious injuries along the U.S. Atlantic coast (2017–2021) by type of interaction.***

	Type Cause	2017	2018	2019	2020	2021	Total
Mortalities	Fishery Interaction[a]	10	10	8	4	3	35
	Boat Strike	4	2	1	2	0	9
	Shot	0	0	0	1	0	1
	Human Interaction - Other	3	9	13	2	1	28
Serious Injuries	Fishery interaction	41[b]	35	24	9	9	118
	Disentangled and released[c]	7	7	25	22	13	74
	Human interaction - other	2	11	5	8	5	31
TOTAL		67	74	76	48	31	296

[a]Fishery interaction mortalities are not added to the total annual estimated human-caused mortality presented in Table 3 because they are subsumed in the total estimated mortality calculated from observer data.
[b]Includes 24 observed interactions from Iruzun Martins et al. 2019.
[c]Injuries on animals that have been disentangled and released are considered to not be serious. These animals are not included in Table 3.

Canada

Between 2017–2021, the average annual human-caused mortality and serious injury to gray seals in Canadian waters from commercial harvest is 1,018, though up to 60,000 seals/year are permitted (http://www.dfo-mpo.gc.ca/decisions/fm-2015-gp/atl-001-eng.htm). This included: 1,421 in 2017, 64 in 2018, 1,236 in 2019, 2,219 in 2020, and 240 in 2021(DFO 2022). In addition, between 2017 and 2021, an average of 2,080 nuisance animals per year were killed. This included 3,368 in 2017, 3,462 in 2018, 3,571 in 2019, (DFO 2017), 0 in 2020, and 0in 2021, based on the total number of licenses that were issued. Lastly, DFO took 90 animals in 2017, 61 animals in 2018, 66 animals in 2019, 127 animals in 2020, and 75 animals in 2021 for scientific collections, for an annual average of 84 animals (DFO 2022).

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