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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal is found on both sides of the North Atlantic, with three major populations: eastern Canada, northwestern Europe and the Baltic Sea (Katona *et al.* 1993). The western North Atlantic population occurs from New England to Labrador and is centered in the Sable Island region of Nova Scotia (Mansfield 1966; Katona *et al*. 1993; Davies 1957; Lesage and Hammill 2001). This stock is separated by geography, differences in the breeding season, and mitochondrial DNA variation from the eastern Atlantic stock (Bonner 1981; Boskovic *et al*. 1996; Lesage and Hammill 2001). There are two breeding concentrations in eastern Canada; one at Sable Island, and a second that breeds on the pack ice in the Gulf of St. Lawrence (Laviguer and Hammill 1993). Tagging studies indicate that there is little intermixing between the two breeding groups (Zwanenberg and Bowen 1990) and, for management purposes, they are treated as separate populations (Mohn and Bowen 1996). However, small numbers of animals and pupping have been observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts (Katona *et al*. 1993; Rough 1995; J. R. Gilbert, pers. comm., University of Maine, Orono, ME). In the late 1990's, a year-round breeding population of approximately 400+ animals was documented on outer Cape Cod and Muskeget Island (Dennis Murley, pers. comm., Mass. Audubon Society, Wellfleet, MA). In December 2001, NMFS initiated aerial surveys to monitor gray seal pup production on Muskeget Island and at the Monomoy National Wildlife Refuge (NWR). Gilbert (pers. comm.) has also documented resident colonies and pupping in Maine since 1994.

POPULATION SIZE

Current estimates of the total western Atlantic gray seal population are not available; although four estimates of portions of the stock are available for select time periods. In 1993 an estimate of the Sable Island and Gulf of St. Lawrence stocks was 143,000 animals (Mohn and Bowen 1996). The population in waters off Maine has increased from about 30 in the early 1970's to 500-1,000 in 1993 and 1,500-1,700 in 2001 (J. R. Gilbert, pers. comm). Recently, 29-49 pups/year have been recorded at one pupping site in Penobscot Bay, and in the winter of 2000, approximately 150 gray seals (adults and pups) were recorded at a second pupping site (J. R. Gilbert, pers. comm.). Maximum counts of individuals obtained during the spring molt at a winter breeding colony on Muskeget Island, west of Nantucket Island, did not exceed 13 in any year during the 1970s, but rose to 61 in 1984, 192 in 1988, 503 in 1992, and 1,549 in 1993. Aerial surveys in April and May of 1994 recorded a peak count of 2,010 gray seals for Muskeget Island and Monomoy combined (Rough 1995). From December 1998 to July 1999 the Northeast Fisheries Science Center conducted aerial surveys in the same region surveyed by Payne and Selzer (1989) and Rough (1995). The peak gray seal count in the region between Isle of Shoals, New Hampshire and Woods Hole, Massachusetts was 5,611 (5/21/99; Table 1). No gray seals were recorded at haulout sites between Newport, Rhode Island and Montauk Pt., New York (Barlas 1999), although, more recently small numbers of gray seals have been recorded in this region (deHart 2002; R. DiGiovanni, pers. comm., Riverhead Foundation, Riverhead, NY). The 1999 count is 2.8 times greater than the 1994 count. Ninety three percent of the gray seals were located at two sites in the eastern end of Nantucket Sound. Fifty-four percent of the seasonal count was on Muskeget Island and adjacent sand bars in Nantucket Sound, and 39% was on Monomoy Island. Recently, a small number of gray seals have maintained a winter presence in the Woods Hole region (Vineyard Sound) (deHart 2002).

Table 1. Summary of abundance estimates for the western North Atlantic gray seal. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{min}) and coefficient of variation (CV).

Month/Year	Area	N_{min} [1]	CV
Spring 1999	Muskeget Island and Monomoy, MA	5,611	none reported
May 2001	Maine coast	1,600	none reported
1999 + 2001	Muskeget Is, Monomoy, and Maine	7,200	none reported

[1] These counts pertain to animals seen in USA waters, and the stock relationship to animals in Canadian waters is unknown.

Minimum Population Estimate

At the November 1998 meeting of the Atlantic Scientific Review Group (ASRG), the ASRG recommended that the minimum estimate (2,010) used in previous assessments be discontinued, because it can not be determined what part of the mortality comes from the Massachusetts, Maine, and Sable Island portions of the population. Therefore, present data are insufficient to calculate the minimum population estimate for USA waters. It is estimated that there are at least 143,000 gray seals in Canada (Mohn and Bowen 1996).

Current Population Trend

Gray seal abundance is likely increasing in the USA Atlantic Exclusive Economic Zone (EEZ), but the rate of increase is unknown. The population in eastern Canada was greatly reduced by hunting and bounty programs, and in the 1950's the gray seal was considered rare (Lesage and Hammill 2001). The Sable Island population was less affected and has been increasing for several decades . Pup production on Sable Island, Nova Scotia, has been about 13% per year since 1962 (Stobo and Zwanenberg 1990; Mohn and Bowen 1996); whereas, in the Gulf of St. Lawrence it is increasing at a slower rate of 7.4% per year (Hammill *et al.* 1998). Approximately 57% of the western North Atlantic population is from the Sable Island stock. In recent years pupping has been established on Hay Island, off the Cape Breton coast (Lesage and Hammill 2001).

Winter breeding colonies in Maine and on Muskeget Island may provide some measure of gray seal population trends and expansion in distribution. Sightings in New England increased during the 1980s as the gray seal population and range expanded in eastern Canada. Five pups were born at Muskeget in 1988. The number of pups increased to 12 in 1992, 30 in 1993, and 59 in 1994 (Rough 1995). Gray seal pups were recorded on three flight days during the 1998/1999 winter surveys (26 January, 9 February, and 10 March). On 9 February, 77 gray seal pups (59 on Muskeget Island and 18 on South Monomoy) were recorded (Barlas 1999). The 1999 NMFS flights only surveyed the Muskeget shoreline and are believed to be negatively biased, since recent anecdotal information suggests that peak pupping occurs by mid-January. In January 2002, between 467-1,023 pups were counted on Muskeget Island and surrounding shoals (S. Wood, pers. comm., University of Massachusetts, Boston, MA). These observations continue the increasing trend in pup production reported by Rough (1995). NMFS recently initiated a collaborative program with the University of Massachusetts, Boston and University of Maine, Orono to monitor gray seal population trends and pup production in New England waters. The change in gray seal counts at Muskeget and Monomoy from 2,010 in 1994 to 5,611 in 1999 represents an annual increase rate of 20.5%, however, it can not be determined what proportion of the increase represents growth or immigration.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. One study that estimated pup production on Sable Island estimated an annual or net productivity increase in pup numbers of 13% (Mohn and Bowen 1996).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al*. 1995).

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). The minimum population size is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) for this stock is 1.0, the value for stocks of unknown status, but is known to be increasing. PBR for the western North Atlantic gray seals in USA waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 1997-2001, the total estimated human caused mortality and serious injury to gray seals is estimated to be 309 per year. The average is derived from three components: 1) 131 (CV=0.26; Table 2) from the 1997-2001 USA observed fishery; 2) 4.6 from average1997-2001 stranding mortalities in USA waters resulting from power plant entrainments, oil spill, shooting, and other sources, and 3) 173 from average 1997-2001 kill in the Canadian hunt (Anon. 2001).

Fishery Information

USA

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Fisheries Observer Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Northeast Multispecies Sink Gillnet

In 1993, there were approximately 349 full and part-time vessels in the Northeast multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). An additional 187 vessels were reported to occasionally fish in the Gulf of Maine with gillnets for bait or personal use; however, these vessels were not covered by the observer program (Walden 1996) and their fishing effort was not used in estimating mortality. In 1998, there were approximately 301 vessels in this fishery (NMFS unpublished data). Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 6%, and 4% for 1990- 2001, respectively. The fishery has been observed in the Gulf of Maine and in southern New England. There were 47 gray seal mortalities observed in the

Northeast multispecies sink gillnet fishery between 1993 and 2001. Twenty-one of the observed mortalities occurred in winter (January - May), 9 in the southern Gulf of Maine, 2 in the "mid-coast closed area", and 2 in the South Cape closure. Only 1 mortality was observed in northern Maine waters, which occurred in autumn (September-December) 1995. One of the 1993 observed mortalities was in May and was from SE of Block Island. Both observed mortalities in 2001 were during the summer (June-Aug).

Annual estimates of gray seal bycatch in the Northeast multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual mortalities (CV in parentheses) from this fishery was 0 in 1990-1992, 18 in 1993 (1.00), 19 in 1994 (0.95), 117 in 1995 (0.42), 49 in 1996 (0.49), 131 in 1997 (0.50), 61 in 1998 (0.98), 155 in 1999 (0.51), 193 in 2000 (.55), and 117 in 2001 (.59). The 1995 bycatch includes 28 animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of bycatch of harbor seals, gray seals, harp seals, and hooded seals. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. There were 0, 1, 5, and 8 unidentified seals observed during 1998 through 2001, respectively. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1997-2001 was 131 gray seals (CV=0.26). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

Mid-Atlantic Coastal Gillnet

Observer coverage of the USA Atlantic coastal gillnet fishery was initiated by the NEFSC Fisheries Observer program in July 1993; and from July to December 1993, 20 trips were observed. During 1994 and 1995, 221 and 382 trips were observed, respectively. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records which are held by both state and federal agencies have not been centralized and standardized. Observer coverage, expressed as percent of tons of fish landed, was 5%, 4%, 3%, 5%, 2%, 2%, and 2% for 1995, 1996, 1997, 1998, 1999, and 2000, and 2001, respectively (Table 2).

No gray seals were taken in observed trips during 1995-2000. One gray seal was observed taken during a "fish trip" (not "marine mammal trip") in 2001 (Table 2). The gray seal was taken at 44 fathom depth during the month of April off the coast of New Jersey near Hudson Canyon. Observed effort was scattered between Delaware and North Carolina from 1 to 50 miles off the beach. The annual (2001) and mean mortality was not estimated.

CANADA

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 in Bay of Fundy herring weirs (Read 1994). In addition to incidental catches, some mortalities (e.g., seals trapped in herring weirs) were the result of direct shooting, and there were culls of about 1,700 animals annually during the 1970's and early 1980's on Sable Island (Anon. 1986).

There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.

Herring weirs are also distributed throughout the Bay of Fundy; and, it has been reported that 180 weirs were operating in the Bay of Fundy in 1990 (Read 1994).

In 1996, observers recorded 3 gray seals (1 released alive) in Spanish deep-water trawl fishing on the southern edge of the Grand Banks (NAFO Areas 3) (Lens, 1997). Seal bycatches occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

Table 2. Summary of the incidental mortality of gray seal (*Halichoerus grypus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded 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	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Multispecies Sink Gillnet3	97-01	301	Obs. Data Weighout, Logbooks	.06, .05, .06, .06, .04	16, 4, 5, 5, 2	131, 61, 155, 193, 117	.50, .98, .51, .55, .59	131 (.26)
Mid-Atlantic Coastal Gillnet[4]	97-01	Unk [5]	Obs. Data Weighout	.03, .05, .02, .02, .02	0, 0, 0, 0, 1	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0 (0.00)
TOTAL								131(.26)

[1] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Fisheries Observer Program. NEFSC 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.

[2] The observer coverage for the Northeast multispecies sink gillnet fishery is measured in trips. Observer coverage of the mid-Atlantic coastal gillnet fisheries are measured in tons of fish landed.

[3] In 1998, 2000, and 2001 respectively, observed mortality on "marine mammal trips" was 3, 3, and 2 animals. In 1997 and 1999 all observed takes were on marine mammal trips. In 1998, 2000, and 2001 there was 1, 2, and 1 mortalities recorded on "fish trips". Only mortalities observed on "marine mammal trips" are used to estimate bycatch. See Bisack (1997) for "trip" type definitions. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled respectively. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 1998, 1 take was observed in a net without a pinger that was within a marine mammal closure that required pingers. In 1997, 1999 and 2000, respectively, 12, 2 and 2 takes were observed in nets with pingers. In 2001 no gray seals were observed taken in nets equipped with pingers.

[4] The one observed take in the mid-Atlantic gillnet fisheries (2001) was on a "fish trip", therefore no mortality estimate was extrapolated. See Bisack (1997) for "trip" type definitions.

[5] Number of vessels is not known.

Other Mortality

Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960's. This hunt may have severely depleted this stock in USA waters (Rough 1995). In addition, the Cape Cod stranding network has documented several animals with netting or plastic debris around their necks in the Cape Cod/Nantucket area. An unknown level of mortality also occurs in the mariculture industry (*i.e.*, salmon farming) and by deliberate shooting (NMFS unpublished data).

In Canada, gray seals were hunted for several centuries by indigenous people and European settlers in the Gulf of St. Lawrence and along the Nova Scotia eastern shore, and were locally extirpated (Lavigueur and Hammill 1993). By the mid-1900s gray seals were considered to be rare, and in the mid-1960s the population in eastern Canada was estimated to be 5,600 (Mansfield 1966). Since the mid-1960s the population has been increasing. During a bounty program (1976-1983) and a culling program (1967-1983), the average annual removals were 720 and 1,000 seals, respectively (Anon 2001). Between 1993-2000, the annual kill of gray seals by hunters was: 1993 (0), 1994 (40), 1995 (364), 1996 (132), 1997 (72), 1998 (275), 1999 (98), and 2000 (342) (Anon 2001). The traditional hunt of a few hundred animals is expected to continue in 2001 (Anon 2001) off the Magdalen Islands and in other areas, except Sable Island, where commercial hunting is not permitted.

Canada also issues personal hunting licenses, which allows the holder to take 6 grey seals annually (Lesage and Hammill 2001). Hunting is not permitted during the breeding season and some additional seasonal/spatial restrictions are in effect (Lesage and Hammill 2001).

From 1997 to 2001, 197 gray seal strandings were recorded, extending from Maine (25) to North Carolina (1). Most of the strandings were in Massachusetts (72), New York (55), and Maine (25). Twenty-three animals showed signs of human interactions: fishery (8), power plant (3), oil spill (6), shot (1), mutilated (1), boat strike (1) and other (3). Further, some live strandings are euthanized due to the animal's condition, and some sick and injured seals are transported to rehabilitation facilities. Stranding data probably underestimate the extent of fishery-related

mortality and serious injury because not all of the marine mammals which die or are seriously injured wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction.

STATUS OF STOCK

The status of the gray seal population, relative to OSP, in US Atlantic EEZ waters is unknown, but the populations appear to be increasing in Canadian and USA waters. The species is not listed as threatened or endangered under the Endangered Species Act. Recent data indicate that this population is increasing. The total fishery-related mortality and serious injury for this stock is believed to be very low relative to the population size in Canadian waters and can be considered insignificant and approaching zero mortality and serious injury rate. The level of human-caused mortality and serious injury in the US Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

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