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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). 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 (D. 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; S. Wood, pers. comm., University of Massachusetts, Boston, MA). 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 estimates of portions of the stock are available for select time periods. The Canadian population, inhabiting the Gulf of St. Lawrence and Sable Island, appears to be growing. A 1993 survey estimated the population at 144,000 animals (DFO 2003, Mohn and Bowen 1996) and a 1997 survey estimated 195,000 (DFO 2003). While the overall population in increasing, the population at Sable Island is increasing by approximately 13% per year, while the population in the Gulf of St. Lawrence is declining (Bowen *et al*. 2003).

The population in US waters is also increasing. Maine coast-wide surveys conducted during summer (all other surveys were conducted January-May) revealed 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert *et al*. 2005). In 2002, the maximum counts of two breeding colonies in Maine, with number of pups in parentheses, were 193 (9) on Seal Island and 74 (31) on Green Island (S. Wood, pers. comm.). Gray seal numbers are increasing in Massachusetts at Muskeget Island off the coast of Nantucket, and at Monomoy Island, off the coast Chatham, Cape Cod. Pup counts on Muskeget have increased from 0 in 1989 to 1,023 in 2002 (Rough 1995, S. Wood, pers. comm.). Gray seal numbers increase in this region in the spring (April-May) when molting occurs. In April-May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995). In March 1999 a maximum count of 5,611 was obtained in the region south of Maine (between Isles of Shoals, NH and Woods Hole, MA) (Barlas 1999). No gray seals were recorded at haul out sites between Newport, RI and Montauk Pt., NY (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). 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} [a]	CV
March 1999	Muskeget Is. & Monomoy, MA	5,611	None reported
May 2001	Maine coast	1,731	None reported

[a] These counts pertain to animals seen in U.S. waters, and the stock relationship to animals in Canadian waters is unknown.

Minimum Population Estimate

Present data are insufficient to calculate the minimum population estimate for U.S. waters. It is estimated that there are at least 195,000 gray seals in Canada (DFO 2003).

Current Population Trend

Gray seal abundance is likely increasing in the U.S. 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). Bounty and culling programs also occurred between 1976 and 1983, removing approximately 1,720 animals per year (DFO 2002). 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 the population appears to be declining, and may have been declining since 1990 (DFO 2003). 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 1980's 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). In January 2002, between 883-1,023 pups were counted on Muskeget Island and surrounding shoals (S. Wood, pers. comm.). 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 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 estimated an annual or net productivity increase in pup production of 13% on Sable Island (Mohn and Bowen 1996; Bowen *et al*. 2003).

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 U.S. waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 1999-2003, the total estimated human caused mortality and serious injury to gray seals was 274 per year. The average was derived from three components: 1) 141(CV=0.26; Table 2) from the 1999-2003 U.S. observed fishery; 2) 3 from average 1999-2003 stranding mortalities in U.S. waters resulting from power plant entrainments, oil spill, shooting, boat strike, and other sources (NMFS unpublished data), and 3) 130 from average 1999-2003 kill in the Canadian hunt (DFO 2003, Stenson unpublished data).

Fishery Information

Detailed fishery information is given in Appendix III.

U.S.

Northeast Sink Gillnet

There were 52 gray seal mortalities observed in the Northeast sink gillnet fishery between 1993 and 2003. Annual estimates of gray seal bycatch in the Northeast 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 (0.55), 117 in 2001 (0.59), 0 in 2002 and 242 (0.47) in 2003 (Table 2). There were 1, 5, 8, 2, and 2 unidentified seals observed during 1999 to 2003, respectively. 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. Average annual estimated fishery-related mortality and serious injury to this stock attributable to

this fishery during 1999-2003 was 141 gray seals (CV=0.26) (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

Mid-Atlantic Coastal Gillnet

No gray seals were taken in observed trips during 1998-2000, and 2003. One gray seal was observed taken during a "fish trip" (not "marine mammal trip") in 2001 (Table 2). Therefore, the annual (2001) mean mortality was not estimated. 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. In 2002, 65% of sampling was concentrated in one area and not distributed proportionally across the fishery. Therefore, observed mortality is considered unknown in 2002.

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 (Anonymous. 1986).

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 [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[c]	99-03	301	Obs. Data Weighout, Logbooks	.06, .06, .04, .02, .03	5, 5, 2, 0, 5	155, 193, 117, 0, 242	.51, .55, .59, 0, .47	141 (0.26)
Mid-Atlantic Coastal Gillnet[d]	99-03	unk [e]	Obs. Data Weighout	.02, .02, .02, .01, .01	0, 0, 1, unk[g], 0	0, 0, 0[f], unk[g], 0	0, 0, 0, unk[g], 0	0 (0.00)
TOTAL								141 (0.26)

a Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling 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.

b The observer coverage for the Northeast sink gillnet fishery is measured in trips. Observer coverage of the Mid-Atlantic coastal gillnet fisheries are measured in tons of fish landed.

c 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. 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.

d 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.

e Number of vessels is not known.

f The annual mortality was not estimated because the observed take occurred on a "fish trip" and not a "marine mammal trip."

g Sixty-five percent of sampling in the Mid-Atlantic coastal gillnet by the NEFSC fisheries observer program was concentrated in one area off the coast of Virginia. Because of the low level of sampling that was not distributed proportionately throughout the Mid-Atlantic region observed mortality is considered unknown in 2002. The four year average (1999-2001, and 2003) estimated mortality was applied as the best representative estimate.

Other Mortality

Canada: 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 1900's gray seals were considered to be rare, and in the mid 1960's 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 and culling program (1967-1983), the average annual removals were 1,720 seals (DFO 2002). From 1999 to 2003 the annual kill of gray seals by hunters was: 1999 (98), 2000 (342), 2001 (76) 2002 (126), and 2003 (6) (DFO 2003; Stenson unpublished data). The traditional hunt of a few hundred animals is expected to continue off the Magdalen Islands and in other areas, except Sable Island where commercial hunting is not permitted (DFO 2003).

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).

U.S: 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 U.S. waters (Rough 1995). Other sources of mortality include human interactions, storms, abandonment by the mother, disease, and predation. Mortalities caused by human interactions include boat strikes, fishing gear interactions, power plant entrainment, oil spill/exposure, harassment, and shooting. The Cape Cod stranding network has documented gray seals entangled in netting or plastic debris around the Cape Cod/Nantucket area, and in recent years have made successful disentanglement attempts.

From 1999-2003, 321gray seal strandings were recorded, extending from Maine to North Carolina. Most strandings were in Massachusetts (136), New York (55), and Maine (31). Fifteen (4.6%) of the seals stranded during this five year period showed signs of human interaction as a direct cause of mortality. The total number of gray seal strandings in 2002 and 2003 are presented in Table 3.

Table 3. Gray seal (*Halichoerus grypus*) reported strandings along the U.S. Atlantic coast (2002-2003).

STATE	2002	2003	TOTAL
Maine	7	6	13
New Hampshire	0	1	1
Massachusetts	43	64	107
Rhode Island	3	7	10
Connecticut	0	0	0
New York	14	13	27
New Jersey	3	14	17
Delaware	0	1	1
Maryland	0	0	0
Virginia	0	2	2
North Carolina	1	0	1
Total	71	108	179

STATUS OF STOCK

The status of the gray seal population relative to OSP in U.S. Atlantic EEZ waters is unknown, but the populations appear to be increasing in Canadian and U.S. 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. Although PBR cannot be determined for this stock, the level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

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