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: in 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 (Katona *et al.* 1993; Davies 1957). This stock is separated by both geography and differences in the breeding season from the eastern Atlantic stock (Bonner 1981). The western North Atlantic stock is distributed and breeds principally in eastern Canadian waters (Mansfield 1966). 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 (Hammill *et al.* 1998). 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 recent years, a year-round breeding population of approximately 400 animals has been documented on outer Cape Cod and Nantucket Island (Dennis Murley, pers. comm., Mass. Audubon Society, Wellfleet, MA). Gilbert (pers. comm.) has also documented a resident colony in Maine.

POPULATION SIZE

Estimates of the total western Atlantic gray seal population are not available; however, four estimates of portions of the stock are available for Sable Island, the Maine coast, and Muskeget Island (Nantucket) and Monomoy, (Cape Cod) Massachusetts (Table 1). The 1993 estimate of the Sable Island and Gulf of St. Lawrence stocks was 143,000 animals (Mohn and Bowen 1994). The population in waters off Maine has increased from about 30 in the early 1980's to between 500-1,000 animals in 1993; recently 29-49 pups/year have been recorded in Penobscot Bay (J. R. Gilbert, pers. comm.). Maximum counts of individuals at a winter breeding colony on Muskeget Island, west of Nantucket Island obtained during the spring molt 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). No gray seals were recorded at haulout sites between Newport, Rhode Island and Montauk Pt., New York (Barlas 1999). 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.

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

Month/Year	Area	N_{min}	CV
1993	Sable Island and Gulf of St. Lawrence	143,000	none reported
1993	Maine coast	500-1000	none reported
Apr-May 1994	Muskeget Island and Monomoy, MA (only USA portion of stock)	2,010	none reported
Spring 1999	Muskeget Island and Monomoy, MA (only USA portion of stock)	5,611	none reported

Minimum Population Estimate

At the November 1998 meeting of the Atlantic Scientific Review Group (SRG), the SRG 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 Massachusettes, 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 has been increasing for several decades in Canadian waters. 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% (Hammill *et al.* 1998). Approximately 57% of the western North Atlantic population is from the Sable Island stock.

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 1998/99 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). These observations continue the increasing trend in pup production reported by Rough (1995). 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 and 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 the annual production rate was 13% (Mohn and Bowen 1994).

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 known to be increasing. PBR for the western North Atlantic gray seals in USA waters is unknown. Applying the formula to the minimum population estimate for Canadian waters results in a "PBR" of 8,850 gray seals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 1994-1998 was 75 gray seals (CV=0.28; Table 2).

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) Sea Sampling 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%, and 5% for 1990 to 1998, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. There were 35 gray seal mortalities observed in the Northeast multispecies sink gillnet fishery between 1993- 1998 (Table 2). Nineteen of the observed mortalities occurred in winter (January - May), 7 in the southern Gulf of Maine and one in the "mid-coast closed area." Only one 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.

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 during 1990-1996 was zero 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), and 61 in 1998 (0.98). 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. Further, they will likely have little impact on the estimates presented. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1994-1998 was 75 gray seals (CV=0.28). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

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; it has been reported that 180 weirs were operating in the Bay of Fundy in 1990 (Read 1994).

In 1996, observers recorded three gray seals (one released alive) in Spanish deep water trawl fishing on the southern edge of the Grand Bank (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 [3]	Estimated Mortality [3]	Estimated CVs	Mean Annual Mortality
Northeast Multispecies Sink Gillnet	94-98	301	Obs. Data Weighout, Logbooks	.07, .05, .04, .06, .05	3, 7, 3, 16, 4	19, 117, 49, 131, 61	.95, .42, .49, .50, .98	75 (0.28)
TOTAL								75 (0.28)

[1] 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 Weighout (Weighout) landings data, 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 some fishing effort in the Northeast multispecies sink gillnet fishery.

[2] The observer coverage for the Northeast multispecies sink gillnet fishery is measured in trips.

[3] In 1994, 1995 and 1998 respectively, observed mortality on "marine mammal trips" was 2, 6 and 3 animals. Only these mortalities were used to estimate total gray seal bycatch. In 1994, 1995 and 1998 one mortality in each year was recorded on a "fish trip." See Bisack (1997) for "trip" type definitions. In 1997 all observed takes were on marine mammal trips, including 12 taken on pingered trips. In 1998 takes from nonpingered nets within a marine mammal time/area closure that required pingers were pooled with the takes from nets with pingers from the same stratum. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 1998 one take was observed in a net without a pinger that was within a marine mammal closure that required pingers.

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, V. Rough (pers. comm.) has documented several animals with netting 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).

The 1992-1996 gray seal strandings data are currently under review. In 1997-1998, 103 gray seal stranding were recorded, extending from Maine (17) to Maryland (2). Most of the stranding were in Maine (17), Massachusetts (28), and New York (28). Thirteen animals showed signs of human interactions: fishery (3), power plant (2), oil spill (4), shot (1), mutilated (1), other (2). 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 USA 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 USA Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

REFERENCES

Anon. 1986. Seals and sealing in Canada. Rep. of the Royal Commission on Seals and Sealing, Vol. 1, 65 pp. Available from Canadian Government Publishing Centre, Ottawa, Canada.

Bonner, W. N. 1981. Grey seal, *Halicoerus grypus. In*: S. H. Ridgway and R. J. Harrison (eds.), Handbook of Marine Mammals, Vol. 2. Pp. 111-144. London: *Academic Press*.

Barlas, M. E. 1999. The distribution and abundance of harbor seals (*Phoca vitulina concolor*) and gray seals (*Halichoerus grypus*) in southern New England, winter 1998- summer 1999. MA Thesis, Boston University, Graduate School of Arts and Sciences., Boston, MA. 52 pp.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Bisack, K. D. 1997. Harbor porpoise bycatch estimates in the New England multispecies sink gillnet fishery: 1994 and 1995. *Rep. int Whal. Comm.* 47:705-14.

Bravington, M. V. and K. D. Bisack. 1996. Estimates of harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-93. Rep. int Whal. Commn. 46:567-574. Bonner, W. N. 1981. Grey seal *Halichoerus grypus Fabricus*, 1791. Pages 111-144 *in* S. H. Ridgway and R. J. Harrison (eds), Handbook of Marine Mammals, Vol. 2: Seals. *Academic Press*, London, 359 pp.

Davies, J. L. 1957. The geography of the gray seal. *J. Mamm.* 38: 297-310.

Hammill, M.O., G.B. Stenson, R.A. Myers and W.T. Stobo. 1998. Pup production and population trends of the grey seal (*Halichoerus grypus*) in the Gulf of St. Lawrence. *Can. J. Fish. Aquat. Sci.* 55:423-430.

Katona, S. K., V. Rough and D. T. Richardson. 1993. A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland. *Smithsonian Institution Press*, Washington, DC. 316 pp.

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. *ICES C.M.* 8/Q. 10 pp.

Mansfield, A.W. 1966. The grey seal in eastern Canadian waters. *Can. Audubon Mag.* 28:161-166.

Mohn, R. and W. D. Bowen. 1996. Grey seal predation on the eastern Scotian Shelf: Modelling the impact on Atlantic cod. *Can. J. Aquat. Sci.* 53:2722-2738.

Payne, P. M. and L. A. Selzer. 1989. The distribution, abundance and selected prey of the harbor seal, *Phoca vitulina concolor*, in southern New England. *Mar. Mammal Sci.* 5(2): 173-192.

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. *Rep. int Whal. Commn.* Special Issue 15: 133-147.

Rough, V. 1995. Gray seals in Nantucket Sound, Massachusetts, winter and spring, 1994. Final report to Marine Mammal Commission, Contract T10155615, 28 pp. NTIS Pub. PB95-191391.

Stobo, W. T. and K. C. T. Zwanenburg. 1990. Grey seal (*Halichoerus grypus*) pup production on Sable Island and estimates of recent production in the northwest Atlantic. Pages 171-184 *in:* W. D. Bowen (ed), Population biology of sealworm (*Pseudoterranova decipiens*) in relation to its intermediate and seal hosts. *Can. Bull. Fish. and Aq. Sci.* 222.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Walden, J. 1996. The New England gillnet effort survey. NOAA, NMFS, NEFSC, Woods Hole, Massachusetts. NEFSC [Northeast Fisheries Science Center] Ref. Doc. 99-10. 38 pp.

Zwanenberg, K.C.T. and W.D. Bowen. 1990. Population trends of the grey seal (*Halichoerus grypus*) in eastern Canada. Pgs. 185-197 *in*: W.D. Bowen (ed.), *Population Biology of Sealworm (Pseudoterranova decipiens) in Relation to its Intermediate and Seal Hosts*. Can. Bull. Fish. and Aq. Sci. 222.