December 1998

HARBOR SEAL (*Phoca vitulina*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal is found in the western North Atlantic, from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Boulva and McLaren 1979; Katona *et al*. 1993; Gilbert and Guldager 1998). Although the stock structure of the western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population (Temte *et al.*. 1991). Breeding and pupping normally occurs in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte *et al.*. 1991; Katona *et al.*. 1993).

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona *et al*. 1993), and occur seasonally along the southern New England and New York coasts from September through late May (Schneider and Payne 1983). Scattered sightings and strandings have been recorded as far south as Florida (NMFS unpublished data). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Rosenfeld *et al.*. 1988; Whitman and Payne 1990). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine Coast (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994). No pupping areas have been identified in southern New England (Payne and Schneider 1984). The overall geographic range throughout coastal New England has not changed significantly during the last century (Payne and Selzer 1989).

The majority of animals moving into southern New England waters are juveniles. Whitman and Payne (1990) suggest that the age-related dispersal may reflect the higher energy requirements of younger animals.

POPULATION SIZE

Since passage of the MMPA in 1972, the number of seals along the New England coast has increased nearly five-fold. Coast-wide aerial surveys along the Maine coast have been conducted in May/June during pupping in 1981, 1982, 1986, 1993, and 1997 (Table 1; Gilbert and Stein 1981; Gilbert and Wynne 1983, 1984; Kenney 1994; and Gilbert and Guldager 1998). These numbers are considered to be a minimum abundance estimate because they are uncorrected for animals in the water or outside the survey area. Increased abundance of seals in the northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites in southern New England and eastern Long Island (Payne and Selzer 1989; Rough 1995). Canadian scientists counted 3,600 harbor seals during an August 1992 aerial survey in the Bay of Fundy (Stobo and Fowler 1994), but noted that the survey was not designed to obtain a population estimate.

Table 1. Summary of abundance estimates for the western Atlantic harbor 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
May/June 1981	Maine coast	10,540 (676)[1]	None reported
May/June 1982	Maine coast	9,331 (1,198)	None reported
May/June 1986	Maine coast	12,940 (1,713)	None reported
May/June 1993	Maine coast	28,810 (4,250)	None reported
May/June 1997	Maine coast	30,990 (5,359)	None reported
August 1992	Bay of Fundy	3,600	None reported

[1]Pup counts are in brackets

Minimum Population Estimate

A minimum population estimate is 30,990 seals, based on uncorrected total counts along the Maine coast in 1997.

Current Population Trend

The annual increase since 1993 has been 1.8 % (Gilbert and Guldager 1998). Since 1981, the average increase has been 4.2 % (Gilbert and Gualdager 1998), about 50% of the 8.9 percent annual increase estimated Kenney (1994) from counts through 1993. Similarly, the number of pups along the Maine coast has increased at an annual rate of 12.9% over the 1981-1997 period (Gilbert and Guldager 1998). Possible factors contributing to this increase include MMPA protection and increased prey. There are no indications that population growth has slowed or that it is at or near its potential maximum level. The rapid increase observed during the past two decades may reflect past reduction of the population by historical bounty hunting, possibly to a very low level.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. 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 30,990. The maximum productivity rate is 0.12, the default value for pinnipeds. The recover factor (F_R) for this stock is 1.0, the value for stocks with unknown population status, but know to be increasing. PBR for counts in U.S. waters is 1,859.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during 1992-1996 was 898 harbor seals (CV = 0.11; Table 2).

Harbor seals were bounty hunted in New England waters until the late 1960's. This hunt may have caused the demise of this stock in U.S. waters (Katona *et al*. 1993). Researchers and fishery observers have documented incidental mortality in several fisheries, particularly within the Gulf of Maine (see below). An unknown level of mortality also occurs in the aquaculture industry (i.e., salmon farming), and by deliberate shooting (NMFS unpublished data).

Fishery Information

USA

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fishery 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.

Incidental takes of harbor seals have been recorded in groundfish gillnet, herring purse seine, halibut tub trawl, and lobster fisheries (Gilbert and Wynne, 1985 and 1987). A study conducted by the University of Maine reported a combined average of 22 seals entangled annually by 17 groundfish gillnetters off the coast of Maine (Gilbert and Wynne 1987). All seals were young of the year and were caught from late June through August, and in early October. Interviews with a limited number of mackerel gillnetters indicated only one harbor seal entanglement and a negligible loss of fish to seals. Net damage and fish robbing were not reported to be a major economic concern to gillnetters interviewed (Gilbert and Wynne 1987).

Herring purse seiners have reported accidentally entrapping seals off the mid-coast of Maine, but indicated that the seals were rarely drowned before the seine was emptied (Gilbert and Wynne 1985). Capture of seals by halibut tub trawls are rare. One vessel captain indicted that he took one or two seals a year. These seals were all hooked through the skin

and released alive, indicating they were snagged as they followed baited hooks. Infrequent reports suggest seals may rob bait off longlines, although this loss is considered negligible (Gilbert and Wynne 1985).

Incidental takes in lobster traps in inshore waters off Maine are reportedly rare. Captures of approximately two seal pups per port per year were recorded by mid-coastal lobstermen off Maine (Gilbert and Wynne 1985). Seals have been reported to rob bait from inshore lobster traps, especially in the spring, when fresh bait is used. These incidents may involve only a few individual animals. Lobstermen claim that seals consume shedding lobsters.

New England Multispecies Sink Gillnet

In 1993, there were approximately 349 full and part-time vessels in the New England 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. Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, and 4% for 1990 to 1996, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. There were 224 harbor seal mortalities, excluding three animals taken in the 1994 pinger experiment (NMFS unpublished data), observed in the New England multispecies sink gillnet fishery between 1990 and 1996. Annual estimates of harbor seal by-catch in the New England 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 602 in 1990 (0.68), 231 in 1991 (0.22), 373 in 1992 (0.23), 698 in 1993 (0.19), 1,330 in 1994 (0.25), 1,179 in 1995 (0.21), and 911 in 1996 (0.27). The 1994 and 1995 by-catches, respectively, include 14 and 179 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 by-catch of harbor seals, gray seals, harp seals, and hooded seals. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1992-1996 was 898 harbor seals (CV = 0.11). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). The by-catch occurred in Massachusetts Bay, south of Cape Ann and west of Stellwagen Bank during January-March. By-catch locations became more dispersed during April-June from Casco Bay to Cape Ann, along the 30 fathom contour out to Jeffreys Ledge, with one take location near Cultivator Shoal and one off southern New England near Block Island. Incidental takes occurred from Frenchman's Bay to Massachusetts Bay during July-September. In inshore waters, the takes were aggregated while offshore takes were more dispersed. Incidental takes were confined from Cape Elizabeth out to Jeffreys Ledge and south to Nantucket Sound during October-December.

CANADA

An unknown number of harbor 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). Furthermore, some of these mortalities (e.g., seals trapped in herring weirs) are the result of direct shooting. The Canadian government has recently implemented a pilot program that permits mariculture operators to use acoustic deterrents or shoot problem seals.

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 seven harbor seals (one released alive) in Spanish deep water trawl fishing on the southern edge of the Grand Bank (NAFO Areas 3) (Lens, 1997). Seal by-catches 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 harbor seal (Phoca vitulina) 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
New England Multispecies Sink Gillnet	92-96	349	Obs. Data Weighout, Logbooks	.07, .05, .07, .05, .04	24, 22, 86, 56, 36	373, 698, 1330, 1179, 911	.23, .19, .25, .21, .27	898 (.11)
TOTAL								898 (.11)

[1] Observer data (Obs. Data) are used to measure by-catch 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 New England multispecies sink gillnet fishery.

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

[3] In 1994, 1995 and 1996, respectively, observed mortality on "marine mammal trips" was 59, 41 and 37 animals. Only these mortalities were used to estimate total harbor seal by-catch. In 1994, 3 mortalities were observed on "fish trips" and 24 on "pinger trips." In 1995, 15 mortalities were recorded on "fish trips". In 1996 two mortalities were recorded on "pinger trips" and three on "fish trips". See Bisack (1997) for "trip" type definitions.

Other Mortality

Annually, small numbers of harbor seals regularly strand throughout their migratory range. Most stranding, however, occur during the winter period in southern New England and mid- Atlantic regions (NMFS unpublished data). However, the 1992-1997 harbor seal strandings data are currently under review and will be provided in the 1999 report. Sources of mortality include human interactions (boat strikes and fishing gear, power plant intake (12-20 per year; NMFS unpubl. Data), oil, shooting), storms, abandonment by the mother, and disease (Katona *et al*. 1993; NMFS unpublished data). Interactions with Maine salmon aquaculture operations appears to be increasing, although the magnitude of interactions and seal mortalities has not been quantified (Anon 1996). In 1980, more than 350 seals were found dead in the Cape Cod area from an influenza outbreak (Geraci *et al*. 1981).

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 may 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 harbor seals, relative to OSP, in the U.S. Atlantic EEZ is unknown, but the population is increasing. The species is not listed as threatened or endangered under the Endangered Species Act. Gilbert and Guldager (1998) estimated a 4.4% annual rate of increase of this stock in Maine coastal waters based on 1981, 1982, 1986, 1993, 1997 surveys conducted along the Maine coast. The population is increasing despite the known fishery-related mortality. Total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be approaching zero mortality and serious injury rate. This is not a strategic stock because human-related mortality and serious injury does not exceed PBR.

REFERENCES

Anon. 1996. Report of the Gulf of Maine Aquaculture-Pinniped Interaction Task Force. Available from NMFS, Office of Protected Resources. Silver Springs, MD. 70 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.*

Boulva, J. and I. A. McLaren. 1979. Biology of the harbor seal, *Phoca vitulina*, in eastern Canada. *Bull. Fish. Res. Bd. Can. 200:1-24.*

Bravington, M. V. and K. D. Bisack. 1996. Estimates of harbor porpoise by-catch in the Gulf of Maine sink gillnet fishery, 1990-93. *Rep. int. Whal. Commn. 46:567-574.*

Geraci, R., D. J. St. Aubin and I. K. Barker. 1981. Mass mortality of harbor seals: pneumonia associated with influenza A virus. *Science 215: 1129-1131.*

Gilbert, J.R. and N. Guldager. 1998. Status of harbor and gray seal populations in northern New England. Final Report to: National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA. Under NMFS/NER Cooperative Agreement 14-16-009-1557. 13 pp.

Gilbert, J.R. and J.L. Stein. 1981. Harbor seal populations and marine mammal fisheries interactions. 1981 annual report. Northeast Fisheries Science Center. Contract NA-80-FA-C-00029.

Gilbert, J.R. and K.M. Wynne. 1983. Harbor seal populations and marine mammal fisheries interactions, 1982. Second annual report. Northeast Fisheries Science Center. Contract NA-80-FA-C-00029.

Gilbert, J.R. and K.M. Wynne. 1984. Harbor seal populations and marine mammal fisheries interactions, 1983. Third annual report. Northeast Fisheries Science Center. Contract NA-80-FA-C-00029.

Gilbert, J. R. and K. M. Wynne. 1985. Harbor seal populations and fisheries interactions with marine mammals in New England, 1984. Interim Rep., NOAA NA-84-EAC-00070, NMFS, NEFSC., Woods Hole, MA, 15 pp.

Gilbert, J. R. and K. M. Wynne. 1987. Marine mammal interactions with New England gillnet fisheries. Final Report Contract No. NA-84-EAC-00070, NOAA, NMFS, NEFSC, Woods Hole, MA, 12 pp.

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.

Kenney, M.K. 1994. Harbor seal population trends and habitat use in Maine. M.S. Thesis. University of Maine, Orono, ME. 55 pp.

Kenney, M. K. and J. R. Gilbert. 1994. Increase in harbor and gray seal populations in Maine. Dept. of Commerce, NOAA-NMFS Contract Rep. 50-EANF-2-00064, 19 pp.

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

Payne. P. M. and D. C. Schneider. 1984. Yearly changes in abundance of harbor seals, *Phoca vitulina*, at a winter haul-out site in Massachusetts. *Fish. Bull., U.S. 82: 440-442.*

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. Mamm. 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.*

Richardson, D.T. 1976. Assessment of harbor and gray seal populations in Maine 1974-1975. Final report to Marine Mammal Commission. Contract No. MM4AC009.

Rosenfeld M., M. George and J. M. Terhune. 1988. Evidence of autumnal harbour seal, *Phoca vitulina*, movement from Canada to the United States. *Can. Field-Nat. 102(3): 527-529.*

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.

Schneider, D. C. and P. M. Payne. 1983. Factors affecting haul-out of harbor seals at a site in southeastern Massachusetts. *J. Mamm. 64(3): 518-520.*

Stobo, W.T. and G.M. Fowler. 1994. Aerial surveys of seals in the Bay of Fundy and off southwest Nova Scotia. *Can. Tech. Rep. Fish. Aquat. Sci. 1943:57 pp.*

Temte, J.L., M.A. Bigg and O. Wiig. 1991. Clines revisited: the timing of pupping in the harbour seal *(Phoca vitulina*). *J. Zool. Lond. 224: 617-632.*

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. 38p.

Whitman, A. A. and P. M. Payne. 1990. Age of harbour seals, *Phoca vitulina concolor*, wintering in southern New England. *Can. Field-Nat. 104(4): 579-582.*

Wilson, S. C. 1978. Social organization and behavior of harbor seals, *Phoca concolor*, in Maine. Final Report to Marine Mammal Commission, Contract MM6ACO13, GPO-PB-280-188.