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HOODED SEAL (*Cystophora cristata*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The hooded seal occurs throughout much of the North Atlantic and Arctic Oceans (King 1983) preferring deeper water and occurring farther offshore than harp seals (Sergeant 1976a; Campbell 1987; Lavigne and Kovacs 1988; Stenson *et al.* 1996). The world's hooded seal population has been divided by ICES into three separate stocks, each identified with a specific breeding site (Lavigne and Kovacs 1988; Stenson *et al.* 1996): Northwest Atlantic, Greenland Sea ("West Ice"), and White Sea ("East Ice"). The Western North Atlantic stock (synonymous with the ICES Northwest Atlantic stock), whelps off the coast of eastern Canada and is divided into three whelping areas. The Front herd (largest) breeds off the coast of Newfoundland and Labrador, Gulf herd breeds in the Gulf of St. Lawrence, and the third area is in the Davis Strait.

Hooded seals are highly migratory and may wander as far south as Puerto Rico (Mignucci-Giannoni and Odell 2001), with increased occurrences from Maine to Florida. These appearances usually occur between January and May in New England waters, and in summer and autumn off the southeast U.S. coast and in the Caribbean (McAlpine *et al.* 1999; Harris *et al.* 2001; Mignucci-Giannoni and Odell 2001). Although it is not known which stock these seals come from, it is known that during spring, the northwest Atlantic stock of hooded seals are at their southernmost point of migration in the Gulf of St. Lawrence.

Hooded seals remain on the Newfoundland continental shelf during winter/spring (Stenson *et al.* 1996). Breeding occurs at about the same time in March for each stock. Adults from all stocks then assemble in the Denmark Strait to molt between late June and August (King 1983; ICES 1995), and following this, the seals disperse widely. Some move south and west around the southern tip of Greenland, and then north along the west coast of Greenland. Others move to the east and north between Greenland and Svalbard during late summer and early fall (Lavigne and Kovacs 1988). Little else is known about the activities of hooded seals during the rest of the year until they assemble again in February for breeding.

POPULATION SIZE

The number of hooded seals in the western North Atlantic is relatively well known and is derived from pup production estimates produced from whelping pack surveys.. Several estimates of pup production at the Front are available. Hooded seal pup production between 1966 and 1977 was estimated at 25,000 - 32,000 annually (Benjaminsen and Oritsland 1975; Sergeant 1976b; Lett 1977; Winters and Bergflodt 1978; Stenson *et al.* 1996). Estimated pup production dropped to 26,000 hooded seal pups in 1978 (Winters and Bergflodt 1978). Pup production estimates began to increase after 1978, reaching 62,000 (95% CI. 43,700 - 89,400) by 1984 (Bowen *et al.* 1987). Bowen *et al.* (1987) also estimated pup production in the Davis Strait at 18,600 (95% C.I. 14,000 - 23,000). A 1985 survey at the Front (Hay *et al.* 1985) produced an estimate of 61,400 (95% C.I. 16,500 - 119,450). Hammill *et al.* (1992) estimated pup production to be 82,000 (SE=12,636) in 1990. Assuming a ratio of pups to total population of 1:5, pup production in the Gulf and Front herds would represent a total population of approximately 400,000-450,000 hooded seals (Stenson 1993). Based on the 1990 survey, Stenson *et al.* (1996) suggested that pup production may have increased at about 5% per year since 1984. However, because of exchange between the Front and the Davis Strait stocks, the possibility of a stable or slightly declining level of pup production was also likely (Stenson 1993; Stenson *et al.* 1996). In 1998 and 1999, surveys were conducted to estimate pup production in the southern Gulf of St. Lawrence, which is the smallest component of the northwest Atlantic stock (ICES 2001). The estimate of 2,000 was similar to the previous published 1990 estimate (Hammill *et al.* 1992; ICES 2001).

Surveys of all three whelping areas in the Northwest Atlantic were carried out in 2005. Pup production at the Front was estimated to be 107,013 (SE = 7,558, CV = 7.1%) while 6,620 (SE = 1,700, CV = 25.8%) pups were estimated to have been born in the Gulf and 3,346 (SE = 2,237, CV = 66.8%) in Davis Strait. Total pup production in the northwest Atlantic was 116,900 (SE = 7,918, CV = 6.8%). Fitting pup production estimates from all herds and making assumptions about numbers of hooded seals in the Davis Strait herd for years when this area was not included in the survey program, results in an estimate of total population in 2005 of 592,100 (SE=94,800; 95% C.I.= 404,400-779,800).

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 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for western North Atlantic hooded seals is 592,100 (SE = 94,800). The minimum population estimate based on the 2005 pup survey results is 512,000. Present data are insufficient to calculate the minimum population estimate for U.S. waters.

Current population trend

Comparison with previous estimates suggests that pup production (and total population size) may have increased since the mid 1980s but the considerable uncertainty about the relationship among whelping areas makes it difficult to reliably assess the population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The most appropriate data are based on Canadian studies. 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 512,000. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) for this stock is 0.5, the value for stocks with unknown population status. PBR for the western North Atlantic hooded seal stock is 15,360 but for U.S. waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2000-2004, the total estimated human caused mortality and serious injury to hooded seals was 4,818. This is derived from two components: 1) an average catch of 4,793 seals from 2000-2004 by Canada and Greenland of the Northwest Atlantic and West Ice stocks (2000 = 1,950; 2001= 3,960; 2002 = 7,341; 2003 = 5,446, and 2004 = 5,270) (ICES 2006); and 2) 25 seals (CV=0.82) from the observed U.S. fisheries (Table 1). Note that there is considerable intermixing between the Northwest Atlantic and West Ice stocks, so it is possible that Northwest Atlantic seals are taken by Greenland sealers.

Fishery Information

Detailed fishery information is reported in Appendix III.

U.S.

Northeast Sink Gillnet

The fishery has been observed in the Gulf of Maine and in southern New England. There were 2 hooded seal mortalities observed in the Northeast sink gillnet fishery between 1990 and 2004. Annual estimates of hooded 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 during 1990-2003 were 0 in 1990-1994, 28 in 1995 (0.96), 0 in 1996-2000, 82 in 2001 (1.14), 0 in 2002-2003, and 43 (0.95) in 2004. The 1995 bycatch includes 5 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. There were 5, 8, 2, 2, and 9 unidentified seals observed during 2000-2004, 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 2000-2004 was 25 hooded seals (CV=0.82) (Table 1). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). The bycatch in 2001 occurred in summer (July-September). All bycatch was in waters between Cape Ann and New Hampshire.

CANADA

An unknown number of hooded seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994).

Hooded seals are being taken in Canadian lumpfish and groundfish gillnets and trawls; however, estimates of total removals have not been calculated to date.

Table 1. Summary of the incidental mortality of hooded seal (*Cystophora cristata*) 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 [c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	00-04	301	Obs. Data Weighout, Logbooks	.06, .04, 02, .03, .06	0, 1, 0, 0, 1	0, 82, 0, 0, 43	0, 1.14, 0, 0, .95	25 (0.82)
TOTAL								25 (0.82)

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center Observer 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 sink gillnet fishery.

b. The observer coverage for the Northeast sink gillnet fishery is measured in tons of fish landed.

c. Only mortalities observed on marine mammal trips were used to estimate total hooded seal bycatch. See Bisack (1997) for "trip" type definitions. The one hooded seal mortality observed in 2001 was taken in a net equipped with pingers. The one hooded seal mortality observed in 2004 was taken in a net not equipped with pingers.

Other Mortality

In Atlantic Canada, hooded seals have been commercially hunted at the Front since the late 1800s. In 1974 total allowable catch (TAC) was set at 15,000, and reduced to 12,000 in 1983 and to 2,340 in 1984 (Stenson 1993; ICES 1998). From 1991 to 1992 the TAC was increased to 15,000. A TAC of 8,000 was set for 1993, and held at that level through 1997. From 1974 through 1982, the average catch was 12,800 animals, mainly pups. Since 1983 catches ranged from 33 in 1986 to 6,425 in 1991, with a mean catch of 1,001 between 1983 and 1995. Catches peaked in 1996 (25,754); the high catch was attributable to good ice conditions and strong market demand. Since 1996, catches have fallen markedly and during 2000-2004 averaged 169 animals per year (ICES 2006). A series of management regulations have been implemented for the Canadian harvest since 1960. For example, the taking of bluecoats was prohibited in 1993 and the TAC has been set at 10,000 seals per year since 1998 (ICES 2006).

In 1988-1993, strandings were fewer than 20 per year, and from 1994 to 1996 they increased to about 50 per year (Rubinstein 1994; Rubinstein, pers. comm.) From 2000 to 2004, 207 hooded seal strandings were reported (2000=30, 2001=86, 2002=30, 2003=20, and 2004=41), in most states from Maine to Virginia (Table 2; NMFS unpublished data). Three (1.5%) of the seals stranded during this five year period showed signs of human interaction as a direct cause of mortality, (1 in 1999, 1 in 2000, and 1 in 2003). Extralimital strandings have also been reported off the southeast U.S., North Carolina to Florida, and in the Caribbean (McAlpine *et al.* 1999; Mignucci-Giannoni and Odell 2001; NMFS, unpublished data).

Table 2. Hooded seal (*Cystophora cristata*) reported strandings along the U.S. Atlantic coast (2002-2004).				
State	**2002**	**2003**	**2004**[a]	**Total**
Maine	14	10	15	39
New Hampshire	1	1	2	4
Massachusetts	10	4	13	27
Rhode Island	0	0	0	0
Connecticut	0	0	0	0
New York	2	2	5	9
New Jersey	2	2	2	6
Delaware	1	1	3	5
Maryland	0	0	1	1
Virginia	0	0	0	0
Total	30	20	41	91
a. During 2004, the Northeast region had 37 seal strandings where species could not be determined.				

STATUS OF STOCK

The status of hooded seals relative to OSP in U.S. Atlantic EEZ is unknown, but the stock's abundance appears to be increasing. The species is not listed as threatened or endangered under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for this stock is very low relative to the stock's size, and can be considered insignificant and approaching zero mortality and serious injury rate. Because the level of human-caused mortality and serious injury is also low relative to overall stock size; therefore, this is not a strategic stock.

REFERENCES CITED

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.

Benjaminsen, T., and T. Oritsland. 1975. The survival of year-classes and estimates of production and sustainable yield of northwest Atlantic harp seals. Int. Comm. Northwest Atl. Fish. Res. Doc. 75/121.

Bowen, W.D., R.A. Myers, and K. Hay. 1987. Abundance estimation of a dispersed, dynamic population: Hooded seals (*Cystophora cristata*) in the Northwest Atlantic. Can. J. Fish. Aquat. Sci. 44:282-295.

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.

Campbell, R.R. 1987. Status of the hooded seal, *Cystophora cristata*, in Canada. Can. Field Nat. 101:253-265.

DFO [Dept. of Fisheries and Oceans]. 2001. Atlantic Seal Hunt: 2001 management plan. Available from Canadian Department of Fisheries and Oceans, Ottawa, Ontario Canada, K1A OE6, Resource Management - Atlantic. 34 pp.

Hammill, M.O., G.B. Stenson, and R.A. Myers. 1992. Hooded seal (*Cystophora cristata*) pup production in the Gulf of St. Lawrence. Can. J. Fish. Aquat. Sci. 49:2546-2550.

Harris, D.E., B. Lelli, G. Jakush, and G. Early. 2001. Hooded seal (*Cystophora cristata*) records from the southern Gulf of Maine. Northeast. Nat. 8:427-434.

Hay, K., G.B. Stenson, D. Wakeham, and R.A. Myers. 1985. Estimation of pup production of hooded seals (*Cystophora cristata*) at Newfoundland during March 1985. Can. Atl. Fish. Sci. Adv. Comm. 85/96.

ICES. 1995. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 5-9 June 1995, Dartmouth, Nova Scotia Canada. NAFO SCS Doc. 95/16. Serial No. N2569. 40 pp.

ICES. 1998. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 28 August - 3 September 1997, Copenhagen, Denmark. ICES CM 1998/Assess:3. 35 pp.

ICES. 2001. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 2-6 October 2000, Copenhagen, Denmark. ICES CM 2001/ACFM:08. 40 pp.

ICES. 2006. Report of the ICES/NAFO Working Group on Harp and Hooded Seals. 12-16 June 2006. Copenhagen, Denmark. ICES Advisory Committee on Fishery Management. ICES CM 2006/ACFM:32 28 pp.

King, J.E. 1983. Seals of the World. Cornell University Press, Ithaca, NY, 240 pp.
Lavigne, D.M. and K.M. Kovacs. 1988. Harps and Hoods Ice Breeding Seals of the Northwest Atlantic. University of Waterloo Press, Waterloo, Ontario, Canada, 174 pp.
Lett, P.F. 1977. A model to determine stock size and management options for the Newfoundland hooded seal stock. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 77/25.
Mignucci-Giannoni, A.A. and D.K. Odell. 2001. Tropical and subtropical records of hooded seals (*Cystophora cristata*) dispel the myth of extant Caribbean monk seals (*Monachus tropicalis*). Carib. Bull. Mar. Sci. 68:47-58.
McAlpine, D.F., P.T. Stevick, L.D. Murison, and S.D. Turnbull. 1999. Extralimital records of hooded seals (*Cystophora Cristata*) from the Bay of Fundy and northern Gulf of Maine. Northeastern Naturalist 6:225-230.
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.
Rubinstein, B. 1994. An apparent shift in distribution of ice seals, *Phoca groenlandica*, *Cystophora cristata*, and *Phoca hispida*, toward the east coast of the United States. M.A. Thesis, Boston University, Boston, MA, 45 pp.
Sergeant, D.E. 1976a. History and present status of populations of harp and hooded seals. Biol. Conserv. 10:95-117.
Sergeant, D.E. 1976b. Research on hooded seals *Cystophora cristata* Erxleben in 1976. ICNAF Res. Doc. 76/X/126.
Stenson, G.B. 1993. The status of pinnipeds in the Newfoundland region. NAFO SCR Doc. 93/34.
Stenson, GB., R.A. Myers, I-H. Ni and W.G. Warren. 1996. Pup production of hooded seals (*Cystophora cristata*) in the Northwest Atlantic. NAFO Sci. Coun. Studies 26:105-114.
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.
Winters, G. H. and B. Bergflodt. 1978. Mortality and productivity of the Newfoundland hooded seal stock. ICNAF Res. Doc. 78/XI/91.