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 1976; 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. Animals breeding on the "West Ice" are thought to belong to the Northeast Atlantic stock (Hammill and Stenson 2006), though genetics analyses suggest that there is some mixing between the Northeast and Northwest stocks (Coltman *et al*. 2007).

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. Three of 4 hooded seals stranded, satellite tagged, and released in the United States in 2004 migrated to the eastern edge of the Scotian Shelf and the two that were monitored until June ended up on the southeast tip of Greenland. The fourth traveled into the Gulf of St. Lawrence. (WHALENET at http://whale.wheelock.edu). Adults from all stocks assemble in the Denmark Strait to molt between late June and August (King 1983; ICES 1995), and following this, the seals disperse widely (Andersen *et al*. 2010). 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). Baffin Bay and Davis Strait appear to be important foraging areas for hooded seals after the molt (Anderson et al. 2010).

POPULATION SIZE

The number of hooded seals in the western North Atlantic is derived from pup production estimates produced from whelping pack surveys. In the most recent assessment (Hammill and Stenson 2006), a model was fit to estimates of pup production derived from aerial surveys between 1984 – 2005. The model incorporates estimates of age-specific reproductive rates and removals, fit to these pup production estimates, to estimate total population levels in Canada. The most Pup production at the Front was estimated to be 107,900 (SE=18,800, 95% CI: 70,600-143,300) and the total population 535,800 (SE=93,600 95%CI; 350,600-711,300). For all herds, which includes assumptions about the number of hooded seals in the Davis Straight, pup production was estimated to be 120,100 (SE=13,800 95%CI: 94,100-147,900), and the total population to be 593,500 (SE=67,200 95%CI: 465,600-728,300). There is uncertainty in these estimates due to limited surveys, limited reproductive data, and uncertainty in stock relationships and harvest statistics. In Canada the Northwest Atlantic Stock of hooded seals is considered to be "data poor", which means that there is no current information (≤5 years old) on fecundity and/or mortality to determine sustainable levels of exploitation and there is not more than three abundance estimates over a 15-year period, the last estimate being obtained within the past 5 years (Hammill and Stenson 2007).

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 593,500 (CV=0.10). The minimum population estimate is 543,549. Present data are insufficient to calculate the minimum population estimate for U.S. waters.

Current population trend

The total Northwest Atlantic hood seal population size has increased from 478,000 (SE=41,800; 95% C.I.=400,500-564,300) in 1965 to 593,500 (SE=67,200, 95% CI=465,600-728,300) in 2005 (Hammill and Stenson 2006). However, uncertainty about the relationship among whelping areas and lack of reproductive and mortality data 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, which assume the maximum net productivity rate to be 0.12 (ICES 2006). 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 in U.S. waters 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 which are known to be increasing. PBR for the portion of the western North Atlantic hooded seal stock in U.S. waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2012-2016, the average estimated human caused mortality and serious injury to hooded seals was 1,680 per year in the U.S., Canada, and Greenland. This is derived from two components: 1) an average catch of 1,679 seals from 2012-2014 (2012= 1666; 2013 = 1520; 2014 = 1852, 2015 and 2016 data from Greenland not available) by Canada and Greenland (ICES 2016); and 2) 0.6 hooded seals (CV=1.12) from the observed U.S. fisheries (Table 1). The majority of harvesting occurs in Greenland and there is some uncertainty in the accuracy of reported harvests (ICES 2016).

Fishery Information

Detailed fishery information is reported in Appendix III.

U.S.

Mid-Atlantic Gillnet

A single hooded seal was taken by an observed mid-Atlantic gillnet trip in 2016 (Orphanides 2019). See Table 1 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

CANADA

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

Table 1. Summary of the incidental serious injury and mortality of hooded seal (Cystophora cristata) by commercial fishery including the years sampled, the type of data used, the annual observer coverage, the serious injuries and mortalities recorded by on-board observers, the estimated annual mortality, the estimated CV of the annual mortality and the mean annual combined mortality (CV in parentheses).

Fishery	Years	Data Type	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Gillnet	2012	Obs. Data, Weighout	0.02	0	0	0	0	0	0.6 (1.12)
	2013		0.03	0	0	0	0	0	
	2014		0.05	0	0	0	0	0	
	2015		0.06	0	0	0	0	0	
	2016		0.08	0	1	0	3	1.12	
TOTAL		-	-	-	-	-	-		0.6 (1.12)

Other Mortality

In Atlantic Canada, hooded seals have been commercially hunted at the Front since the late 1800's. A series of management regulations have been implemented for the Canadian harvest since 1960. The TAC for the Northwest Atlantic stock for hooded seals was reduced from 10,000 to 8,200 in 2007 where it has remained since (ICES 2016). The taking of "blueback" pups (animals <14 months) has been prohibited since 1987 (Hammill and Stenson 2016).

From 2012 to 2016, 4 hooded seal stranding mortalities were reported, with the majority in Massachusetts (Table 2; NOAA National Marine Mammal Health and Stranding Response Database, accessed 03 November 2017)). Several other hooded seal strandings were responded to and the seal left at site or brought to rehabilitation. None of the mortalities during this five year period showed signs of human interaction. 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). Harris and Gupta (2006) analyzed NMFS 1996-2002 stranding data and suggest that the distribution of hooded seal stranding in the Gulf of Maine is consistent with the species seasonal migratory patterns in this region.

Table 2. Hooded seal (Cystophora cristata) stranding mortalities along the U.S. Atlantic coast (2012-2016) with subtotals of animals recorded as pups in parentheses.

State	2012	2013	2014	2015	2016	Total
MA	0	2	1	0	0	3
NY	1 (1)	0	0	0	0	1
Total	1	2	1	0	0	4
Unspecified seals (all states)	28	25	38	31	13	135

STATUS OF STOCK

The status of hooded seals relative to OSP in U.S. Atlantic EEZ is unknown, and the trend in the stock's abundance is uncertain. The species 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, this is not a strategic stock.

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