

## Northwest Atlantic Harp Seals

### Background

The Harp seal is an abundant, medium sized seal which migrates annually between Arctic and sub-Arctic regions of the north Atlantic. Male harp seals are only slightly larger than females with adults averaging 1.6m in length and 130 kg in weight. Harp seals give birth ("whelp") on the ice in the White Sea, near Jan Mayen Island and in the northwest Atlantic. The northwest Atlantic breeding stock, historically the largest, summers in the Canadian Arctic and Greenland. In the fall most of these seals migrate southward to the Gulf of St. Lawrence ("Gulf"), or to the area off southern Labrador and northern Newfoundland ("Front") where they give birth in late February or March. Females nurse a single pup for about twelve days, after which they mate and then disperse. The pup, known as a whitecoat, moults its white fur at approximately three weeks of age. Older harp seals form large moulting concentrations on the sea ice off northeastern Newfoundland and in the northern Gulf of St. Lawrence in April and May. Following the moult, seals disperse and eventually migrate northward. Small numbers of harp seals may remain in southern waters throughout the summer.



### Summary

- Northwest Atlantic harp seals are harvested in Canadian and Greenland waters. After a period of reduced catches from 1983 – 1995, Canadian catches increased significantly to between 240,000 and 280,000 since 1996. Greenland catches have increased steadily since the mid 1970's and are currently estimated to be over 100,000.
- Total removals of harp seals was estimated by including reported catches, estimates of bycatch in the Newfoundland lumpfish fishery and estimates of seals killed but not recovered during the harp seal hunts in Canada and Greenland. Total removals have been relatively stable since 1997, at around 465,000 seals annually.

- The harp seal population declined during the 1960's and reached a minimum of less than 2 million in the early 1970's. Since then it increased steadily until the mid 1990's. Due to the large harvests in recent years, the population has been stable since 1996 at the highest level since the time series began in 1960.
- The estimated population size of northwest Atlantic harp seals for 2000 is 5.2 million (there is a 95% chance that it is in the range of 4.0 – 6.4 million).
- Using aerial surveys, the total pup production of harp seals in 1999 was estimated to be approximately 1,000,000 pups (range 800,000 to 1,200,000). Pup production has been increasing since the early 1980's.
- Harp seals consume substantial amounts of prey in Canadian waters. A high portion of the diet is fish, with some invertebrate prey as well. The vast majority of fish prey are small forage fish; commercial species make up only a small portion of their diet. Due to the complex nature of interactions within ecosystems, it is not possible to quantify the impact this predation is having on the status of commercial fish stocks.

### *The Fishery*

Harp seals have been hunted commercially since the early eighteenth century. About 250,000 animals were harvested per year at the beginning of the century but the hunt declined during the First World War to about 150,000 from 1919 to 1939. Commercial harvesting almost stopped completely during World War Two, but then it increased rapidly reaching 450,000 in 1951 and averaging about 288,000 seals per year from 1952 to 1971.

The first TAC was set in 1971 at 245,000 and varied until 1982 when it was set at 186,000. During this period, the average annual catch was approximately 165,000 seals. Prior to 1983, the large-vessel take of pups on the whelping patch accounted for the majority of the harvest. A ban on the importation of whitecoat pelts implemented by the European Economic Community in 1983 severely reduced the market, ending the traditional large-vessel hunt. From 1983 to 1995 catches remained low, averaging 52,000 per year. The quota was increased to 250,000 in 1996 and 275,000 in 1997. Catches increased again

**Table 1: TAC and commercial catches of harp seals ('000s) in Atlantic Canada 1972-1999.**

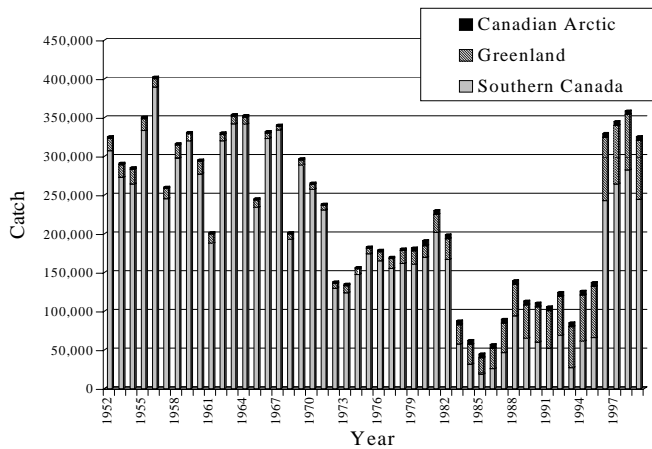
|       | 1972-82 | 1983-95 | 1996 | 1997 | 1998 | 1999 |
|-------|---------|---------|------|------|------|------|
| TAC   | 175     | 186     | 250  | 275  | 275  | 275  |
| Catch | *165    | *52     | 242  | 264  | 282  | 244  |

\* Annual average

to over 240,000 between 1996 and 1999. Young of the year seals that have moulted their whitecoat ('beaters') make up the vast majority of the recent catches. Harp seals are currently hunted by land-based sealers in both the Gulf and Front areas during the winter. Current regulations do not allow the hunting of whitecoats or the use of vessels greater than 20m.

Harp seals are also hunted in the Canadian Arctic and Greenland. There are no recent statistics for the Canadian Arctic but during the late 1970's catches were thought to range between 1,200 and 6,500. Prior to 1980, catches in Greenland were consistently less than 20,000 animals. Since then, however, catches have steadily increased to over 89,000 in 1998. Preliminary estimates indicate that Greenland catches may be over 100,000 in 1999 (Fig. 1).

**Figure 1: Reported catches of harp seals in the northwest Atlantic 1952-1999.**



In addition to reported catches, some seals are killed but not recovered (referred to as 'struck and lost'). Recently, studies have been carried out to estimate the additional mortality caused by struck and lost. Loss rates for young of the year seals which make up the majority of the harvest in Canada appear to be low (less than 5%) while losses of older seals is higher (assumed to be 50%). This higher figure is also applied to catches in the Canadian Arctic and Greenland when estimating total removals.

Harp seals are also taken incidentally as bycatch in fishing gear. A recent study of the numbers of seals taken as bycatch in the Newfoundland lumpfish fishery estimated that fewer than 10,000 animals were taken annually from the start of the fishery in 1968 until 1984. Since 1984, bycatches have been more variable, ranging between 3,000 and 36,000 per year. Recent bycatches (1996-1998) have varied between 16,000 and 23,000 seals annually. Although it is thought that the lumpfish fishery produces the largest bycatch mortality of seals, additional seals are taken in other fisheries, but the numbers caught have not been estimated. A small number of harp seals (~380/yr) are taken in fishing gear in the northeastern U.S.

In order to estimate the total removals of northwest Atlantic harp seals that are used in the population model, reported catches in Canada and Greenland are combined with estimates of bycatches and struck and lost. Total removals have been approximately stable since 1997, at around 465,000 seals annually.

### *Resource Status*

The total number of harp seals in the northwest Atlantic cannot be counted directly. Surveys of the total population are impractical because harp seals are distributed widely across the Arctic and north Atlantic during the summer and, even though they congregate during the whelping and moulting periods, not all of the population is present at the surface at any one time and place. However, because pups remain on the ice while being nursed, harp seal populations can be assessed by estimating pup production (births) as a first step. Then by incorporating information on the pregnancy rates of female seals and the ages of seals caught, a population model can be constructed and the total population size estimated.

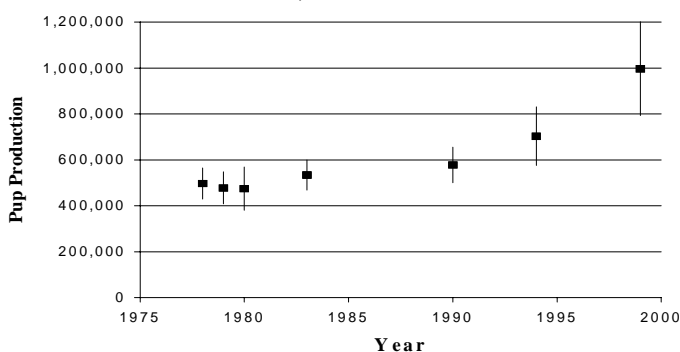
In the past, pup production has been estimated by examining catch data, mark-recapture experiments or aerial survey techniques. The results for similar time periods were often conflicting. Estimates for the mid to late 1970's ranged from approximately 250,000 to 500,000. The Royal Commission on Seals and Sealing in Canada concluded that pup production in 1978 was in the order of 300,000 - 350,000 and the total population was 1.5 - 1.75 million. Aerial surveys, of the Front and Gulf of St. Lawrence flown during the 1990's estimated a pup production of  $580,000 \pm 78,000$  pups in 1990 and  $703,000 \pm 125,000$  in 1994.

## 1999 Pup Production

The most recent estimate of harp seal pup production in the Gulf of St. Lawrence and at the Front was obtained from surveys conducted by the Department of Fisheries and Oceans in March 1999. Extensive reconnaissance flights were carried out to find the whelping concentrations and monitor their movements. Both visual and photographic surveys were conducted to estimate pup production. The total number of pups born was estimated to be  $739,000 \pm 189,000$  at the Front,  $176,000 \pm 50,000$  in the southern Gulf, and  $83,000 \pm 44,000$  in the northern Gulf. Because it is unlikely that any whelping concentrations were missed, the total pup production for 1999 was in the order of  $998,000 \pm 200,000$  (Fig. 2).

Total pup production has increased throughout the 1990's. In the most recent survey, the number of pups born increased in the northern Gulf and at the Front, while the total number of animals born in the southern Gulf declined compared to 1994. These changes may be due to the movement of females among whelping areas. The proportion of the total production in each area varies among years. Traditionally, one third of the pups are thought to be born in the Gulf but this proportion varies greatly among years. In 1999, about 25% of total pup production occurred in the Gulf.

**Figure 2: Estimates of pup production and 95% confidence intervals, 1978-99.**



## Population Dynamics

Catch-at-age data are obtained from the reported catch statistics and by direct sampling of seals caught by commercial sealers and researchers. Teeth are removed from jaws and the ages determined by reading lines within the teeth.

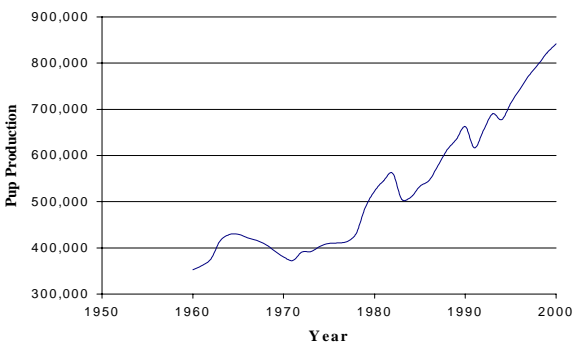
The reproductive tracts of females are examined to determine whether they are mature, if they had a pup the previous year, and if they are pregnant again. It is now clear that pregnancy rates have varied considerably since the 1950s. The percentage of mature females that were pregnant increased from the mid 1950's (85%) to the mid 1960's (95%). However, it has dropped significantly from approximately 90% in the early 1980's to only 70% during the early 1990's. It appears to have increased slightly (72%) in the mid 1990's. The age at which females become sexually mature has also changed. In the early 1950's the average age at which they matured was 5.8 years whereas in the early 1980's it was 4.6 years. By the mid 1990's it had increased to approximately 5.6 years. The exact timing of the recent changes cannot be determined since they occurred at a time when few reproductive samples were available. However, they appear to have taken place since the mid 1980's. The pregnancy rates and age at maturity influence strongly the calculations of population estimates.

## Total Population

A harp seal population model, incorporating information on pup production since the late 1970's, reproductive rates since 1960 and catch at age data since 1952, has been developed to provide estimates of pup production and total population.

The population model indicates that pup production has increased relatively steadily since the early 1970's. Slight declines were estimated during the early 1980's and 1990's, reflecting lower pregnancy rates, but the estimated number of pups born during these periods is dependent upon the way in which the reproductive data are incorporated in the model (Fig. 3). Uncertainty in the timing of the decline in reproductive rates makes it difficult to determine the extent of the increase in pupping in recent years.

**Figure 3: Estimates of pup production 1960-2000.**

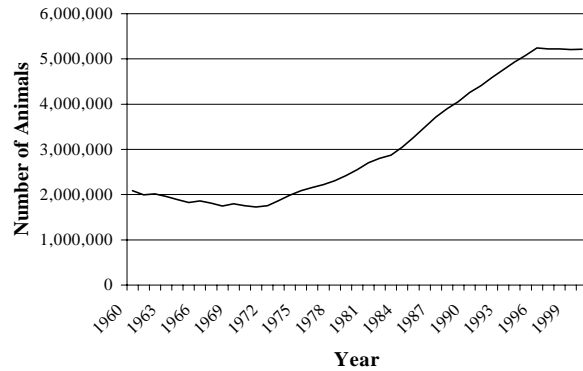


Estimates of the total population declined during the 1960's, reached a minimum in the early 1970's, and then increased steadily to 1996 (Fig. 4). Since then the population appears to have remained relatively stable at the highest values in the time series. The total population in 2000 was estimated to be approximately 5.2 million (95% C.I. 4.0 – 6.4 million). The uncertainty associated with the estimates of pup production are accounted for in the confidence intervals. Additional uncertainty associated with reproductive rates, total removals and the age of catches have not been included and therefore these confidence intervals are underestimates of the total uncertainty.

Although an increase in pup production is apparent in both the model and survey estimates since the early 1980's, the population size has stabilized over the past four years due to large catches of young

animals. The impact of these catches on pup production is expected to become apparent in coming years.

**Figure 4: Estimates of total population 1960-2000.**



### Prey Consumption

The consumption of prey by harp seals in the Northwest Atlantic between 1990 and 1999 was estimated using a bioenergetics model. The energy requirements of individuals were estimated based on their size and then extrapolated to the entire population using abundance estimates obtained from the population model. The proportion of energy obtained from various prey species and the amount consumed was estimated using information on the seasonal distribution of animals, the composition of their diet in various areas and the energy content of the prey.

Harp seals spend about half of the year in Arctic areas and the remainder of the year in the Northwest Atlantic and Gulf of St. Lawrence. Total prey consumption in the Northwest Atlantic has increased from 2.5 million tonnes in 1990 to 3.3 million tonnes in 1999. Consumption in the Northwest Atlantic accounts for about 54% of the total annual prey consumption by harp seals, while the remaining 46% occurs in Canadian Arctic and Greenland waters. The major prey off Newfoundland is capelin and Arctic cod (a non-commercial gadoid). Harp

seals consumed an estimated 709,000 tonnes of capelin and 176,000 tonnes of Arctic cod in 1999. Although Atlantic cod is a relatively small component of the diet, the large number of seals present consumed approximately 49,000 tonnes of Atlantic cod.

In the Gulf of St. Lawrence, capelin is the major prey of harp seals whereas Arctic cod forms only a minor component of the diet as it is not common in these waters. In 1994, seals consumed an estimated 314,000 tonnes of capelin and 6,000 tonnes of Arctic cod. In the Gulf, Atlantic cod accounts for about 3% of the total diet; consumption of cod by harp seals was estimated to be 22,000 tonnes in 1999.

The majority of fish eaten by harp seals were 10-20 cm long. The Atlantic cod were primarily 1-2 years old, younger than those taken in the commercial fishery. The capelin eaten were mainly 1-3 years which represents some overlap with commercial fisheries.

These estimates of consumption depend upon a number of assumptions which have various degrees of uncertainty associated with them. The energy requirements of individual seals and the abundance of seals used in the model are thought to be accurately estimated and within the ranges assumed. The areas of greatest uncertainty are due to our lack of knowledge concerning the seasonal distribution of seals and the annual, seasonal and geographic variability in their diet. Relatively small changes in these assumptions could have significant effects on the results. Studies are currently being conducted to improve our knowledge of both the diet and distribution of harp seals. As more data become available, they will be incorporated into the models to improve the estimates of prey consumption.

## *Outlook*

Annual estimates of the percentage of mature females giving birth each year were lower in the mid 1990's than in the early 1980's. These lower reproductive rates are expected to reduce the potential rate of increase in the population in the coming years.

Recent estimates of pup production indicate that it has continued to increase despite large catches since 1996. However the high proportion of young in these catches will affect the breeding population and subsequent pup production in the coming years as these cohorts mature.

Catches of harp seals in Greenland have increased significantly since the early 1990's. Given the high proportion of older animals in this harvest, Greenland catches have a greater impact on the breeding population than a similar level of Canadian catches. If Canadian catches remain at the current levels, continued increases in Greenland harvests will have a negative effect on the population size.

The current level of removals has resulted in a relatively stable population in recent years. However, given the change in age structure of the population resulting from the large number of young seals taken since 1996, continued removals at the same level and age structure would be expected to result in declines in the seal population from current levels.

Long-term predictions of population size of Northwest Atlantic harp seals are not possible due to potential changes in reproductive rates and the highly variable nature of annual catches in Canada. Periodic estimates of pup production and annual monitoring of reproductive rates and

catches are required to determine future trends.

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