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Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals

ICES Headquarters
28 August - 3 September 1997

Table of Contents

1 TERMS OF REFERENCE

In 1984 an ICES Working Group on Harp and Hooded Seals in the Greenland Sea was established (C.Res. 1984/2:4:18); meetings were held in September 1985 and October 1987 (ICES Coop. Res. Rep. 148 and ICES CM 1988/Assess:8). In 1988 the terms of reference were expanded to include harp seals in the White and Barents Seas (C.Res. 1988/2:4:27), and the Working Group met in October 1989 (ICES CM 1990/Assess:8).

In 1989 it was recommended that a Joint ICES/NAFO Working Group on Harp and Hooded Seals be established, with the following mandate (C.Res. 1989/3:1):

> " ... for the purpose of assessing the status of these stocks and providing related advice and information in the areas of both organizations. Contracting Parties to either organization or regulatory commissions who might desire advice on harp and/or hooded seals in a particular geographical area must refer their request to the organization (NAFO or ICES) having jurisdiction over or interest in that area. Advice based on reports of the Joint Working Group would be provided by ACFM in the case of questions pertaining to the official ICES Fishing Areas (FAO Area 27) and by NAFO Scientific Council in the case of questions pertaining to the legally-defined NAFO area. ICES will administrate the Joint Working Group in terms of convening meetings, formulating terms of reference, handling membership and chairman-ship, and processing, printing, and distributing Working Group reports."

Following a request from Norway, the Joint Working Group met for the first time in October 1991 (ICES CM 1992/Assess:5).

The Joint Working Group did not meet in 1992, but reacting upon its recommendation an ICES/NAFO Workshop on Survey Methodology for Harp and Hooded Seals was held 5–12 October 1992 in Archangelsk, Russia (ICES CM 1993/N:2).

Based on a request from Norway, the Joint Working Group met in September 1993 to assess the Greenland Sea stocks of harp and hooded seals, and give advice for the 1994 sealing season in that area (ICES CM 1994/Assess:5).

Based on a request by Denmark (on behalf of Faroe Island and Greenland), the Joint Working Group met in June 1995 to assess the harp and hooded seal stocks in the Northwest Atlantic, and to evaluate the impact of environmental changes and ecological interactions for all North Atlantic stocks of the two species (NAFO SCR Doc. 95/16).

Based on a request forwarded by NAMMCO in May 1995, the present meeting was convened to provide assessment advice on harp seals in the White Sea and Barents Sea, and harp and hooded seals in the Greenland Sea. The terms of references formulated by ACFM in response to this request and questions that arose from the 1993 meeting of the Working Group, were the following:

a) assess the stock size, distributions and pup production of White Sea / Barents Sea harp seals and harp and hooded seals in the Greenland Sea;

b) subject to the availability of data, assess the sustainable yield at present stock sizes and provide catch options in the Barents and White Seas and in the Greenland Sea;

c) review existing population models for harp seals in order to standardise the methodology used to estimate the numbers at age;

d) assess current information on the effect of recent environmental changes or changes in the food supply on harp and hooded seals, and review available data on the possible interaction between these seal species and other living marine resources.

It was noted that the Joint Working Group was not requested to make any assessment, or provide catch options, on the harp and hooded seal stocks in the Northwest Atlantic, but available scientific information on these stocks should be reviewed, when relevant for addressing the terms of reference.

2 MEETING ARRANGEMENTS

The Working Group, chaired by G. Stenson, and comprised of scientists from Canada, Denmark (Greenland), Norway, and Russia, met at the ICES Headquarters in Copenhagen, Denmark from 28 August to 3 September 1997. A list of participants is given in Appendix I.

The Working Group reviewed available information on catches and relevant scientific information on harp and hooded seals, including documents prepared for this meeting. The Agenda adopted for the meeting is shown in Appendix II, and the papers referred to are listed in Appendix III.

3 HARP SEALS (*Phoca groenlandica*)

3.1 Stock Identity, Distribution and Migrations

The Working Group was informed of the results of a study on the stock identity of harp seals using DNA analysis. The cytochrome B gene of 10 seals from each of the Barents Sea, Greenland Sea, Newfoundland (the Front) and Gulf of St. Lawrence areas (E. Perry, Smithsonian Institute, Washington, unpublished data) was sequenced. The observed allele frequencies support previous analyses that indicate a separation between the western and eastern Atlantic groups. Within the Northwest Atlantic area, seals from the Gulf and the Front were closely related. The genetic distance between the Greenland Sea and the Barents Sea samples was greater. The allele patterns observed suggest that the eastern stocks arose earlier than the Northwest Atlantic stock.

The results of a study of the seasonal distribution and migratory patterns of adult harp seals moulting in the Newfoundland area were presented to the Working Group (Stenson and Sjare 1997). Satellite transmitters were deployed on 21 newly moulted seals captured in 1995 (n=11) and 1996 (n=10). Seals were tracked for periods ranging from 22 to 356 days. Seasonal movements varied greatly among individuals and between years, but not between males and females. Harp seals ranged from the northern Scotian Shelf and Grand Banks of Newfoundland in the spring and winter, north to Baffin Bay, southeastern Greenland and Hudson Strait in the summer. Offshore waters of the Grand Banks and Davis Strait appeared to be important feeding areas during the winter and summer, respectively. The occurrence of seals on the southern Grand Banks, Flemish Cap and Scotian Shelf may indicate a southern shift in distribution in recent years. The timing of the annual migrations in 1996 was similar to those reported previously. Both the northward and southward migrations occurred earlier in 1995 than in 1996, but the differences were not significant.

Results of a joint Norwegian/Russian study in the White Sea were presented. During the breeding period (February/March) in 1995, eight lactating harp seals were equipped with satellite-linked dive recorders in order to study their movements and dive behaviour between breeding and moult (Nordøy *et al.*, this meeting, SEA-81). The average longevity of the tags was 56 days, after which they were lost during moult. Results from these taggings showed that during the first 5–10 days, when still lactating, the seals passively followed the northward pack-ice drift. After lactation, four seals moved westward along the Murman coast and two of these continued into Norwegian waters. Two seals moved north into the Barents Sea, while the remaining two stayed in the White Sea until moult. The seals that left the White Sea returned to moult, on average 48 days after tagging (late April). The observed westward feeding migration of adult females in the period between breeding and moult confirms previous observations.

Ten adult harp seals (both males and females) were equipped with satellite-tags after moulting in the White Sea in early May 1996 (Nordøy *et al.*, this meeting, SEA-81). The average longevity of the tags was 237 days. The results confirm the general migration pattern of Barents Sea harp seals described in earlier studies. The seals migrated northwest into the Barents Sea after moult. In July and August they dispersed along the southern edge of the pack-ice belt from 5°W in the Norwegian Sea to 87°E in the northeastern Kara Sea, occasionally as far north as 82°N. While the seals spent much of their time in close association with the pack-ice, frequent foraging trips were made into open waters of the Barents Sea. In late autumn and early winter the seals moved south gradually with the expanding ice cover.

Data on more than 134,000 dives showed both seasonal and regional variations in diving activity and depths. In the periods May–August and September–October, 50–70% and 30–40% of the dives, respectively, were to depths less than 50 m (Nordøy *et al.*, this meeting, SEA-81).

Since 1978, and particularly in 1986–1988, large numbers of harp seals invaded coastal waters of northern Norway during winter and spring. After 1988 harp seal invasions have been restricted to the northeastern parts of the Norwegian coast. In 1995, a significant increase occurred in both the magnitude and the spatial extent of the harp seal invasions. In early winter the seal herds consisted of immature animals (mainly from the 1994 year class), while mature females dominated in the spring. A total of approximately 10,600 harp seals were recorded as by-catches in Norwegian coastal fisheries during the winter 1994/1995 (Nilssen *et al.*, 1996).

Recaptures of immature harp seals tagged in the White Sea (mainly in 1994) suggest that the invading young harp seals in the winter of 1995 belonged to the Barents Sea stock. However, the invasion may also have included immature seals from the West Ice stock where few have been tagged since 1991 (Nilssen *et al.*, 1996). Results from tagging experiments suggest that mixing of immature animals between these two stocks occurs (Øien, this meeting, SEA-88).

3.2 The Greenland Sea Stock of Harp Seals

3.2.1 Information on recent catches and regulatory measures

Available information on Norwegian catches of harp seals in the Greenland Sea pack-ice in 1996 and 1997 is given in Appendix IV, Table 2. Russia did not participate in these two years. The total catches were 6,427 and 2,161 harp seals in 1996 and 1997, respectively. In 1996 half the quota, and in 1997 all the quota, was allowed to be taken as weaned pups, one adult considered equal to two pups. The catches were well below the quota of 13,100 adults. Between 1990–1997 less than 60% of the quota was taken. A total of 170 females, 2 males and 62 pups were caught under a scientific permit in March 1997.

Available information on Norwegian and Russian sealing effort directed towards harp and hooded seals in the West Ice, is given in Appendix IV, Tables 3 and 4.

3.2.2 Current research

During the Norwegian hooded seal survey in the West Ice in March 1997 (Øien, this meeting, SEA-89), a sample of 169 females was collected for studies of reproductive parameters. A Norwegian study has been initiated to look at possible changes in age at sexual maturity for female harp seals in the West Ice from the 1960s until present. Sampling of the pups (see Haug *et al.*, 1996) and 1+ animals taken in commercial catches was continued. Samples were also collected from seals invading the Norwegian coast. Updates of mark-recapture estimates based on recaptures up to and including 1996 have been made (Øien, this meeting, SEA-87). One harp seal tagged in the West Ice in 1990 was recaptured in the East Ice in 1996 (Øien, this meeting, SEA-88). No new taggings of West Ice harp seal pups have been conducted.

Several joint Norwegian-Russian studies are now in progress. Using data collected by Russian scientists in the West Ice in previous years, reproductive parameters and the feeding habits of the animals during the moulting period (Potelov *et al.*, 1997) are being studied. Furthermore, an unsuccessful attempt was made to deploy satellite tags on adult harp seals after the moulting period (mid June) in 1997.

3.2.3 Biological parameters

No new data on biological parameters were presented at this meeting.

3.2.4 Population assessment

Updates of pup production estimates over the period 1977–1991 were provided to the meeting (Øien, this meeting, SEA-87), and are shown in Figure 1. The present estimate of pup production in 1991 is 67,300 (95% C.I. 56,400–78,113). This is similar to the update presented at the 1995 meeting of the Working Group (NAFO SCR Doc. 95/16), and is about 10% higher than the mean estimate used in the assessment carried out in 1993 (CM 1994/Assess:5). The Working Group could not point to any major event that could possibly affect the West Ice harp seal stock adversely since the 1993 assessment.

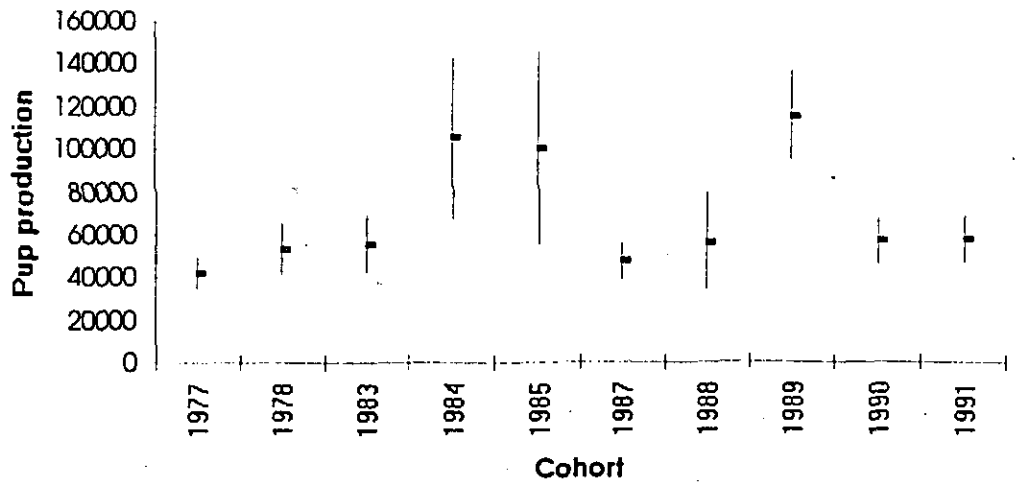

Figure 1. Pup production estimates for harp seals in the Greenland Sea by year for data accumulated up to and including 1995. The bars illustrate the 95% confidence regions around the point estimates.

3.2.5 Catch options

The new estimate of pup production falls within the range investigated at the 1993 meeting of the Working Group (CM 1994/Assess:5 (Table 1)). Therefore, no new catch options were calculated.

	1991 N_0 = 46,000		1994 N_0 = 46,300; N_{1+} = 220,700					
	Exploitation rates of pups of 1+		Catches					
			1994			Equilibrium		
	u_0	u_{1+}	Pups	1+	Total	Pups	1+	Total
a)	0	0.046	0	10,200	10,200	0	10,400	10,400
b)	0.443	0	20,500	0	20,500	24,900	0	24,900
c)	0.225	0.025	10,400	5,500	15,900	11,300	5,500	16,800

	1991 N_0 = 58,000		1994 N_0 = 59,800; N_{1+} = 285,800					
	Exploitation rates of pups of 1+		Catches					
			1994			Equilibrium		
	u_0	u_{1+}	Pups	1+	Total	Pups	1+	Total
a)	0	0.046	0	13,100	13,100	0	13,500	13,500
b)	0.443	0	26,500	0	26,500	32,100	0	32,100
c)	0.225	0.025	13,500	7,100	20,600	14,600	7,100	21,700

	1991 N_0 = 69,000		1994 N_0 = 72,200; N_{1+} = 345,900					
	Exploitation rates of pups of 1+		Catches					
			1994			Equilibrium		
	u_0	u_{1+}	Pups	1+	Total	Pups	1+	Total
a)	0	0.046	0	15,900	15,900	0	16,200	16,200
b)	0.443	0	32,000	0	32,000	38,800	0	38,800
c)	0.225	0.025	16,200	8,600	24,800	17,600	8,600	26,200

Table 1. Catch options for harp seals in the Greenland Sea (from CM 1994/Assess:5).

3.3 The White Sea and Barents Sea Stock of Harp Seals

3.3.1 Recent catches and regulatory measures

Recent Russian and Norwegian catches of harp seals in the White and Barents Sea are listed in Appendix IV, Table 5. The combined catches in 1995, 1996 and 1997 totalled 36,486, 41,049 and 36,399, respectively, i.e. at a level comparable to previous years since 1989. Of these, 249 pups and 60 1+ animals were caught by Norway, and 1,089 1+ animals by Russia, under a scientific permit. The proportion of pups taken ranged between 80.5–86.0%.

Available information on recent sealing regulations for the White and Barents Seas is summarized in Appendix V, Table 2.

3.3.2 Current research

Norwegian research in 1995–1997 included continued sampling for age analyses of catches of moulting seals in the Barents Sea (Nilssen *et al.*, 1996; Øien, this meeting, SEA-88), studies of feeding and condition of weaned pups and 1+ animals taken in catches and for scientific purposes (Haug *et al.*, 1996; Lindstrøm *et al.*, 1996), and development of a model to assess prey consumption by the stock (Nilssen *et al.*, 1997). Samples were also collected from seals invading the Norwegian coast (Nilssen *et al.*, 1996).

In a joint Norwegian-Russian research program, 8 and 10 satellite tags were deployed on adult seals captured in the White Sea in February-March 1995 and May 1996, respectively (Nordøy *et al.*, this meeting, SEA-81).

Russian research in 1995–1997 included new analyses of data from aerial photographic surveys and age samples of females collected on the breeding grounds over the past two decades (Potelov and Svetochev, this meeting, SEA-75), establishment of ogives for the breeding season (Potelov *et al.*, this meeting, SEA-74; Timoshenko, this meeting, SEA-79), and aerial surveys of pups on the breeding grounds using various photographic, video and IR equipment (Chernook *et al.*, this meeting, SEA-76; SEA-77; Potelov *et al.*, this meeting, SEA-74; Shafikov and Chernook, this meeting, SEA-78; Timoshenko, this meeting, SEA-80).

3.3.3 Biological parameters

The were no new data pertaining specifically to biological parameters of the White Sea harp seal population. However, Potelov and Svetochev (this meeting, SEA-75) presented some new calculations of age specific fertility rates and mortality rates based on comparisons between the age structure and age specific catch levels of seals taken on the whelping and moulting patches. The Working Group concluded that these parameters were not appropriate given the potential biases associated with catch data from either whelping or moulting patches (this problem is also discussed in Section 3.4.3). Until more data from the White Sea are available, independent reproductive parameters from the Barents Sea should be used for any modelling of this population. An agreed upon range of mortality values should be assumed.

3.3.4 Population assessment

Pup production

Monitoring the status of the White Sea and Barents Sea stock of harp seals has been carried out using various methods. One method preferred by Russian scientists has been a technique of aerial photographic surveys of adult females on the ice during the whelping period. However, since the proportion of females present on the ice varies, the appropriate correction factor required to estimate pup production is unknown (Potelov *et al.*, this meeting, SEA-74). Results of a recent study on the attendance patterns of female harp seals in the Northwest Atlantic during the whelping period under different environmental conditions (Perry and Stenson, 1997) illustrate the difficulty in determining the appropriate correction factors.

In 1997 two independent aerial surveys, using photographic, visual, video, and thermal (IR) methodology were carried out to assess pup production in the White Sea (Potelov *et al.*, this meeting, SEA-74; Chernook *et al.*, this meeting, SEA-76). In order to evaluate when surveys should be conducted, the distribution of births over time was determined by recording the proportions of different weight groups and/or pelage types of pups throughout the breeding season (Potelov *et al.*, this meeting, SEA-74; Timoshenko, this meeting, SEA-79).

Using strip transect methods Potelov *et al.*(this meeting, SEA-74) surveyed the whelping grounds in the White Sea on 17–20 March 1997. An estimate of 64,698 (95% C.I.: 61,862–67,533) was obtained. Due to rapid changes in the configuration of ice and pup distribution, the areas surveyed constituted only 41% of the total whelping area. Using an isoline method (adapted from fisheries research), an estimate of 161,442 (95% C.I.: 150,425–172,459) pups was obtained for the entire whelping grounds. Adding the quantity of pups taken by Russian sealers in the White Sea prior to the surveys in 1997 (31,319 whitecoats), point estimates of ca 96,000 pups in the strip transect surveys, and ca 193,000 pups using the isoline method, would be obtained.

Results in selected areas where both methods could be applied, were similar. However, the Working Group could not evaluate the appropriateness of using the isoline method to estimate pup production in areas not covered by the line transect surveys. In order to do so, additional information was required concerning how the estimates of densities were obtained and applied. Therefore, the Working Group concluded that the estimates obtained in the strip transect surveys were minima, but that the extent of underestimation was unknown. The Working Group noted that pup production in areas not covered by the strip transect surveys might be obtained using estimates of the average density of pups within various areas provided that samples were obtained randomly.

Another aerial survey of harp seal pups in the White Sea was performed on 12 March 1997, using an aeroplane fitted with photographic, video and thermovision (IR) equipment (Chernook *et al.*, this meeting, SEA-76; SEA-78). All recording devices were applied simultaneously as the plane flew along transects laid out over the whelping grounds. The strip widths covered by the three recording methods were largest for the IR method, smallest for the video method, and both adults and pups appeared clearly visible in all applied methods. The three methods yielded estimates of pup production, uncorrected for the distribution of births over time, of 68,700 $\pm$ 10,800 from the photographic survey, 76,300 $\pm$ 19,900 from the video survey and 89,300 $\pm$ 23,400 from the IR survey. Comparisons of counts obtained during photographic surveys yielded larger differences among individual readers than the other two survey types. Adding the number of pups taken in commercial catches before the survey (31,319), point estimates from the three survey types ranged between 100,000 and 120,000 pups.

The Working Group acknowledged the substantial efforts of Russian scientists to obtain a pup estimate for the East Ice stock of harp seals. It was noted that the estimates given from the 12 March survey by Chernook *et al.* (this meeting, SEA-76) were similar to the strip transect estimates obtained by Potelov *et al.* (this meeting, SEA-74) in the 17–20 March surveys. Comparison of the ogives presented by Potelov *et al.* (this meeting, SEA-74) and Timoshenko (this meeting, SEA-79), with the survey dates indicate that some pups would have reached the ragged jacket stage by the time of the surveys, particularly those in late March. Pups in this stage are known to leave the ice occasionally to pursue prey (Haug *et al.*, 1996), and therefore may not be counted. Thus, all given estimates are likely underestimates, and the Working Group agreed that the pup production for the White Sea and Barents Sea stock of harp seals was probably at least 100,000 in 1997.

The Working Group **recommended** that data obtained during the 17–20 March survey (Potelov *et al.*, this meeting, SEA-76) be reanalysed to estimate pup production in areas not covered in the strip transect survey (Chernook *et al.*, this meeting, SEA-76). It was further **recommended** that the results from the multi-spectral should be reanalysed for possible reading errors. Finally, if future aerial surveys are to be conducted in the White Sea whelping areas, the Working Group would encourage Russian scientists to join their effort in one common survey which covers the entire whelping area and can be corrected for the temporal distribution of births.

It was noted that a joint Norwegian-Russian tagging program had been conducted on the breeding grounds in the White Sea during the period 1989–1995 (Nilssen *et al.*, 1996). Age samples are collected from Norwegian moulting catches in the southeastern Barents Sea (Kjellqwist *et al.*, 1995; Nilssen *et al.*, 1996; Øien, this meeting, SEA-88), a mark-recapture pup production estimate may be available in a couple of years.

Population modelling

A model describing the population dynamics of harp seal pups and 1+ year old females in the White Sea from 1980–1997 was presented (Potelov & Svetochev, this meeting, SEA-75). Pup production estimates and estimates of female numbers were generated under two scenarios using a survival index method based on the age structure of breeding and moulting seals taken during the Russian commercial and scientific hunt. In 1980, aerial photographs of the whelping grounds indicated that there were 138,500 breeding females present. However, considering the large proportion of females that may have been in the water and gone undetected, the authors felt an estimate of 250,000 was more likely. A recent aerial survey conducted in 1997 provided a pup production

estimate of 193,000 (Potelov *et al.*, this meeting, SEA-74) suggesting that production had declined since 1980. Using these data to initialize the model, the population dynamics for pups and females were described from 1980 to 1997 and projections were made to year 2000 using several different catch level scenarios. The major reasons cited for the decline in pup numbers were the decreased number of females in the population and the occasional high mortality of pups and subsequent weak recruitment to the adult stock. It was thought that as the Barents Sea capelin stock recovered there would be a reduction in the mortality of one year old seals resulting in higher number of seals in the younger age groups. However, the model projections indicated that reduced female numbers and low pup production would persist until year 2000 even if the commercial hunt was terminated.

The Working Group commended the authors on their modelling initiative; it represents a significant step forward in the long term management of the White Sea harp seal population. In its present form, the model relies heavily on the age specific catch statistics obtained from seals taken on the whelping and moulting grounds to generate key parameters. The Working Group had serious concerns about using this information in such a manner given the accumulated evidence that strong biases can exist. In addition, it was apparent that the starting point of the model (i.e. 1980) was insufficient to ensure that the age structure had stabilized prior to the projection period. Therefore, the Working Group felt that no specific conclusion about the population dynamics of pups and 1+ aged females from 1980–1997 could be made. However, there was general agreement that the evidence for weak year classes from 1986 to 1989 and possibly from 1993 to 1995 is reliable.

3.3.5 Catch options

Potelov and Svetochev (this meeting, SEA-75) simulated four different catch options in their model (no catch; 20,000; 30,000; and 40,000). However, given the inherent problems with the model, the Working Group could not adequately evaluate nor accept the results. However, the Group agreed that if pup production was in the order of 100,000, then a take of 40,000 may be too high to ensure an equilibrium catch.

To determine the appropriate level of catch, an acceptable age structured population model must be developed. The following parameters would have to be agreed upon: a pup production estimate, age specific reproductive rates, a catch at age matrix, and a range of natural mortalities. All of these parameters are available or can be estimated from existing data. The Working Group **recommends** that priority be given to this modelling initiative.

3.4 The Northwest Atlantic Stock

3.4.1 Information on recent catches and regulatory measures

The Canadian commercial seal hunt has increased dramatically during the last two years (Appendix V, Table 10); in 1996 the catch was 242,362 and in 1997 it was 261,043. These are approximately four times the average taken over the last ten years. There has also been a change in the age structure of the hunt with a significant increase in the proportion of pups taken (76% and 84% respectively). Information on Canadian regulatory measures are presented in Appendix V, Table 3a.

After a period without catch figures for seals in Greenland (1988–92), a new system for collecting harvest data was introduced in October 1992 (Kapel and Rosing-Asvid, 1996). Catches of harp seals reported through this system for the years 1993–95 (53,642, 54,996 and 60,743, respectively) were significantly higher than the estimated catches in previous years. An examination of the official catch statistics for 1954 to 1987 suggests, however, that the figures reported previously for the period 1975–87 (Annex IV, Table 9a) underestimated the true harvest level considerably (Rosing-Asvid), this meeting SEA-86). A method for calculating figures that would provide more realistic estimates of the harp seal catch in Greenland during this period was presented (Rosing-Asvid, this meeting, SEA-86), and the results are presented in Annex IV, Table 9b.

It was agreed that for 1975 and the following years, the estimates given in Table 9b should be used for assessment purposes rather than the official catch statistics (Table 9a). Recaptures of tagged animals have demonstrated that harp seals from all breeding stocks do contribute to catches in Greenland (Kapel, 1996), but it was agreed that when incorporating Greenland catches in population models, all harp seals taken in West Greenland should be considered as deriving from the Northwest Atlantic stock, harp seals taken in Northeast Greenland from the Greenland Sea stock, and harp seals taken in Southeast Greenland should be split equally between the two.

Combining the Canadian and Greenland estimated catches suggests that the current catches are in the order of 300,000. Considering the estimates of replacement yields presented at the last meeting of the Working Group (NAFO SCR Doc. 95/16), it was noted that the recent catches of harp seals in the Northwest Atlantic are near, or at, the established replacement levels.

3.4.2 Current research

Sampling was continued during 1996 and 1997 for studies of the diet, body condition, and age composition of catches in the Newfoundland area. Sampling of moulting harp seals was carried out in 1995 and 1996. The model used to estimate consumption of prey by harp seals was projected forward to 1996 and updated to include all prey species (Hammill and Stenson, 1997). Efforts are underway to incorporate seal consumption into a model used to estimate abundance of Atlantic cod on the southern Labrador Shelf and northern Grand Banks (NAFO areas 2J3KL).

A study of bacular and testicular growth in Northwest Atlantic harp seals has been completed and the results presented to the Working Group (Miller *et al.* 1997). Bacular growth was rapid between ages 3 and 7 with the most rapid growth occurring between 3 and 4 years of age. This supports earlier studies indicating that the majority of harp seals are mature by age 5.

Results of a recent study of the attendance patterns of female harp seals in the Northwest Atlantic during the whelping period under different environmental conditions was presented to the Working Group (Perry and Stenson, 1997). It was shown that the proportion of females present on the ice exhibited a clear diurnal pattern in which few females were present in the mornings but increased to a maximum in the mid-afternoon. The greatest change in the proportion present occurred between the hours of 1000 and 1400, traditionally the peak period for photography. The proportion of females present also varied with environmental conditions; significantly fewer females being present on days with strong winds. These results indicate that efforts to correct counts of adult females on the whelping grounds must take into consideration the specific time of day and environmental conditions when the photographs were taken.

Samples are being collected in West Greenland for studies of feeding ecology, condition, and reproduction. An analysis of a sample of 251 harp seal teeth from recoveries of tagged animals is almost completed (Kapel, this meeting, SEA-83).

3.4.3 Information on the state of the stock

No new data were presented at the meeting.

4 HOODED SEALS (*Cystophora cristata*)

4.1 Stock Identity, Distribution and Migrations

At its previous meeting (NAFO SCR Doc 95/16) the Working Group was informed of the results of a study on the seasonal distribution of hooded seals in the Greenland Sea. A detailed analysis of these data was presented in Folkow *et al.* (1996). Nineteen hooded seals were tagged with satellite transmitters, fifteen following the moulting period in July 1992 and four during the whelping period in March 1993. The average longevity of the transmitters was 199 (SD=84) days and ranged from 43–340 days. In general, the seals remained within the Greenland and Norwegian Sea for the majority of the year. Between July 1992 and March 1993, two of the seals remained near the coast of Northeast Greenland while eight travelled to waters off the Faroe Islands, three to the continental shelf break south of Bear Island, and three to the Irminger Sea. Several seals spent extended periods at sea west of the British Isles, or in the Norwegian Sea between the breeding and moulting periods.

Recaptures of seals, tagged as pups in the Greenland Sea, are consistent with the satellite tagging results (Øien, this meeting, SEA-88).

The seasonal distribution of recent catches of hooded seals in Greenland is in general agreement with the pattern described earlier, with the exception that catches now seem to continue during winter at a somewhat higher level than previously experienced, particularly in Southwest Greenland (Kapel, this meeting, SEA-84). Anecdotal

information supports the evidence that hooded seals now occur more frequently in the coastal waters of Greenland during winter.

4.2 The Greenland Sea Stock of Hooded Seals

4.2.1 Information on recent catches and regulatory measures

Available information on Norwegian catches of hooded seals in the Greenland Sea in 1996 and 1997 is given in Appendix IV, Table 1. Russia did not take part in this hunt during these two years. The total catches were 811 and 2,934 hooded seals in 1996 and 1997, respectively. In 1996 half the quota, and in 1997 all the quota, was allowed to be taken as weaned pups, one adult equal to two pups. The catches were well below the quota (9,000 adults). Between 1990–1997 about 25% of the quota has been taken. A total of 17 females, 18 males and 32 pups were caught under a scientific permit in March 1997.

4.2.2 Current research

During the hooded seal survey, designed primarily to assess the pup production in the West Ice in March 1997 (Øien, this meeting, SEA-89), a sample of 67 hooded seals (females, males and pups) were collected for ecological, toxicological, physiological and anatomical studies. A total of 92 bluebacks were tagged in one whelping patch to the northeast of Jan Mayen. Sampling of ecological data from pups (see Haug *et al.*, 1996) and 1+ animals taken in commercial catches were continued. Based on data collected from hooded seals in the West Ice by Russian scientists in previous years, feeding habits of the species during the moulting period are now being analysed (Potelov *et al.*, 1997).

4.2.3 Biological parameters

No new data on biological parameters were presented at this meeting. The Working Group was informed, however, that a substantial amount of relevant biological material has been collected by Russian scientists over the past years. Some of this material (e.g., teeth for age determination) have not been analysed. Russian scientists were encouraged to complete the analyses of data from their scientific catches and present the results to the Working Group. A joint study between Norwegian and Russian scientists, including exchange of material, was discussed.

4.2.4 Population assessment

In March 1997 a survey using fixed-wing aircraft and shipborne helicopter was conducted in the Greenland Sea pack-ice to estimate hooded seal pup production by photographic and visual methods (Øien, this meeting, SEA-89).The pack-ice between 70°N and 75°N was searched under excellent weather conditions from 17–24 March. The largest patch of breeding hoods was found to the northeast of Jan Mayen, while a number of small patches, family groups, and solitary bluebacks were recorded to the northeast, west, and northwest. Six whelping patches were covered by photography, and the total point estimate for these were 25,300 pups (95% C.I. 18,200 to 35,100)). For the main patch, visual surveys were also carried out, and they seemed to be in agreement with the photographic surveys.

The estimate of 25,300 hooded seal pups produced in 1997 is not corrected for the temporal distribution of births or for scattered pups. Data to determine the birth distributions based on pup stages were collected, primarily from the main whelping patch, but the analyses of these data have not been finished. However, the possibility of being able to correct the estimate for scattered pups seems unlikely. No reconnaissance flights were conducted after 24 March and thus, the question of whelping after this date is left open.

The question of possible overlap among breeding patches will be investigated before the next meeting. If revised estimates of pup production, and a population model are available, the Working Group will be able to assess the Greenland Sea hooded seal stock at its next meeting.

4.2.5 Catch options

No catch options were provided by the Working Group. The Group noted that catch options can be provided once the assessment is completed.

4.3 The Northwest Atlantic Stock

4.3.1 Information on recent catches and regulatory measures

The most recent information on the catch of hooded seals in Greenland (Appendix IV, Table 8) was compared with information gathered during the previous forty years (Kapel, this meeting, SEA-84). The figures for the catch of hooded seals in Greenland 1993 and 1994 (6,906 and 7,330 respectively) are slightly higher than those estimated for the 1980s, but in line with the trend shown since the early 1950s. For most regions the present catch level is within the range estimated for previous decades, but in southwest Greenland the level is higher. Catches of hooded seals during the 1980s were likely underestimated by the previous system of collecting statistics, but revised estimates are not available.

Catches of hooded seals in Canadian waters have been variable over the last two years (Appendix IX, Table 12). In 1996, a total of 25,754 seals were taken, which is more than three times the allowable quota. The majority of these were bluebacks taken prior to March 28. Reasons for this large catch included favorable ice conditions and good prices for the blueback pelt. In 1997, the total number of hooded seals taken was 7,058, just under the allowable quota of 8,000 (Appendix V, Table 3b). In contrast to the previous year, the catch was reported to be adults.

Taking into account Greenland and Canadian catches it appears that in 1996 the total catch of hooded seals in the Northwest Atlantic slightly exceeded the replacement yield estimated at the last meeting of the Working Group (NAFO SCR Doc. 95/16), while in 1997 the total number of seals taken was much lower.

4.3.2 Current research

The Davis Strait hooded seal whelping patch was located by survey aircraft on 17, 21 and 22 March 1997. The seals were first sighted at approximately 63°36'N 57°30'W along the edge of the pack ice; by March 21, they had drifted to the northwest (64°00'N 59°00'W). Although the area could not be searched extensively, there appeared to be only one concentration of seals in the region.

Canadian scientists are currently carrying out a study of reproductive parameters of female hooded seals collected between 1979 and 1996. Preliminary results indicate that age specific pregnancy rates have not changed over that time period. The Working Group was also informed of current efforts to construct a simple population model for Northwest Atlantic hooded seals. This model will be used to estimate the amount of prey consumed by hooded seals in Canadian waters.

Collection of data on reproductive rates, growth rates, condition, diet, and catch-at-age of hooded seals in Newfoundland has been continued. The results of a study of the diet of hooded seals in offshore waters are presented in Hammill and Stenson (1997). This study found that Greenland halibut, witch flounder, squid and Atlantic cod were the major prey of hooded seals collected during the winter along the northern Grand Banks between 1991 and 1996.

4.3.3 State of the stock

Other than confirmation of the Davis Strait whelping patch, no new data pertaining to the state of the Northwest Atlantic hood seal stock were presented.

5 ECOLOGY OF SEAL STOCKS

5.1 Changes in Biological Parameters Due to Environmental Changes

Body condition parameters revealed that harp seals, sampled in coastal areas of northern Norway during a seal invasion in 1995, were in significantly poorer condition than comparable age-groups of harp seals sampled in corresponding seasons in 1992 and 1993. This suggests that the seals may have experienced a food shortage during the winter 1994/1995 (Nilssen *et al.*, 1996).

When capelin is abundant along the Murman and Finnmark coasts in late winter, it is an important prey for harp seals. The collapse of the Barents Sea capelin stock in 1992/1993 resulted in a reduced abundance of capelin in

Norwegian coastal waters and a decrease in the importance of this species as prey for the harp seals. This decline in importance is supported by the dominance of codfishes in the diet in 1995 which was also observed during the major invasions in 1986–1988. A decreased abundance of immature herring in the southern Barents Sea during 1994 and 1995 may also have contributed to the seal invasions that winter. Harp seals are known to also feed on polar cod during late autumn and winter. The stock size of polar cod in the Barents Sea has increased and was estimated at nearly one million tons in 1992 and 1993. This may have been one of the reasons why the harp seal invasions in 1995 included only immature animals.

Variations in the inflow of warm Atlantic water into the Barents Sea can influence the distribution and abundance of fish species in this region. Low water temperatures may lead to changes in the distribution and availability of important prey species for the harp seals and may cause them to move into the western parts of the Barents Sea. A possible southward shift in harp seal distributions in the Northwest Atlantic (Stenson and Sjare, 1997) may also be related to observed variations in the distribution of their prey. Variations in prey availability should be studied with respect to distribution and diets of seals in order to evaluate possible relationships among various parameters.

The very low representation of the 1986–1988 year classes in the age-composition data from the East Ice moulting lairs in 1995 and 1996 supports previously reported recruitment failure to the Barents Sea harp seal stock in this period. The low representation of the 1993, 1994 and 1995 year-classes (Øien, this meeting, SEA-88) also suggests poor survival of these cohorts and decreased recruitment to the stock. However, the poor representation of these year classes could also be related to differences between migration patterns of young and adult seals. It remains to be seen whether future age-composition data will confirm that food shortages have made an impact on these year classes.

Sampling has continued to determine if the declines observed in the condition and reproductive parameters of harp seals in the Northwest Atlantic and Barents Sea have continued, but analysis is not complete.

5.2 Interactions Between Seals and Other Marine Resources

A number of workshops and symposia involving marine mammal and fisheries scientists have been held to address the issue of interactions between seals and other marine resources since the last meeting of the Working Group. These include the NAFO/ICES Symposium on the Role of Marine Mammals in the Ecosystem, the NAFO *ad-hoc* Working Group on the Interrelationships Between Harp and Hooded Seals and Commercial Fish Stocks, the International Scientific Workshop on Harp Seal-Fisheries Interactions in the Northwest Atlantic and the NAMMCO Scientific Committee Working Group on The Role of Minke Whales, Harp Seals and Hooded Seals in the North Atlantic Ecosystem.

The NAFO/ICES Symposium on the Role of Marine Mammals in the Ecosystem was held in Halifax, Canada, 6–8 September 1995 (Anon., 1996). The aim of the Symposium was to attract scientists from relevant disciplines with expertise in different geographical areas to address the question of the role of mammals in the marine ecosystem. The presentations represented different approaches and the current state of our knowledge on environmental, spatial and temporal influences on life histories, foraging strategies and energetic considerations in the diet, marine mammal - fisheries interactions, and theoretical considerations on the role of apex predators and multispecies models. It was clear that a variety of biological and physical components in the ecosystem must be considered in order to determine the role of marine mammals and that co-operation between scientists from various disciplines is necessary. Studies of marine mammal-fisheries interactions should take into account potential secondary interactions, such as other predators or prey, which may result in conclusions which are counter-intuitive. Also, it may not be possible to quantify interactions precisely and therefore, models incorporating uncertainties must be robust.

Following the Symposium, the NAFO Scientific Council established an *ad-hoc* Working Group on the Interrelation between Harp and Hooded Seals and Commercial Fish Stocks in response to a request from the Fisheries Commission (Anon., 1996). The Working Group was asked to review the available data on the consumption of fish by seals, interactions between seals and commercial fish stocks, and to assess effects on the seal stock of recent environmental changes or changes in food supply. Based upon presentations at the NAFO/ICES Symposium and the report of the 1995 meeting of the Joint ICES/ NAFO Working Group on Harp and Hooded Seals (NAFO SCR Doc. 95/16), the *ad-hoc* Working Group provided a number of recommendations on research required to improve our understanding of interrelations between seals and commercial fish stocks.

These recommendations focused on improving our knowledge of prey abundance and the amount of fish consumed by other predators.

Memorial University of Newfoundland and the Canadian Centre for Fisheries Innovation sponsored the International Scientific Workshop on Harp Seal-Fisheries Interactions in the Northwest Atlantic which was held in St. John's, Canada, 24–27 February 1997 (Anon., 1997a). The objectives of the workshop were to: review the current understanding of the biology of Northwest Atlantic harp seals as it relates to interactions with other ecosystem components; evaluate current understanding of harp seal - fishery interactions; identify weaknesses in the available data and gaps in knowledge; identify the most appropriate age structured model(s) for evaluating interactions between harp seals and commercial fisheries; define the nature of the data required in order to run the model(s); and, to provide recommendations for future research required for management. After reviewing the available data, the participants concluded that they could not assess whether or not harp seals were affecting commercial fish stocks, particularly Atlantic cod, on the Labrador-Newfoundland shelf. This was primarily due to a lack of data on the size of the cod stock and information on the amounts of cod taken by other predators. However, it was felt that when these data were available, it would be possible to analyse the effect of predation by harp seals on the Atlantic cod stock.

At the NAMMCO Scientific Committee meeting in Tromsø, Norway, 10–14 March 1997, a Working Group was convened to address questions concerning the role of minke whales and harp and hooded seals in North Atlantic ecosystems (Anon., 1997b). Food consumption of harp and hooded seals were addressed. The magnitude of consumption was fairly well documented for the White Sea and Barents Sea stock of harp seals throughout the year, and for Northwest Atlantic harp and hooded seals during the winter period, i.e. the period they are abundant in Canadian waters. Some information is available on the diets of Northwest Atlantic harp and hooded seals during their stay in Greenland waters. Although the information, particularly on seal abundance in this area, is insufficient to model food consumption of commercial species, it may be that consumption by harp seals is of the same order of magnitude as the commercial fishery in the region. There is a paucity of data on the diet of seals in other areas. The Working Group acknowledged that predation from the two seal species on various fish species was considerable, however, it was emphasized that a number of uncertainties are associated with these consumption estimates and they should be used with caution. An updated estimate of food consumption by White Sea and Barents Sea harp seals (Nilssen *et al.*, 1997) illustrated the sensitivity of the estimates to the model assumptions.

The NAMMCO Working Group also discussed possible interactions between marine mammals and commercially important fish stocks using multispecies modelling (Anon., 1997b). The Barents Sea multispecies model MULTSPEC, which describes interactions between minke whales, harp seals, herring, capelin and cod, was discussed extensively. The preliminary runs performed with this model seemed to indicate effects on prey stocks when marine mammal stocks, including harp seals, change. The herring stock appeared to increase as predation from marine mammals decreased, while the development of the capelin stock was mainly determined by changes in the herring and cod stocks. Generally, the cod stock increased or decreased when marine mammal stocks decreased or increased. It was noted that MULTSPEC might be improved by including polar cod and taking account of seasonal variations in prey preferences. Multispecies models which include harp and/or hooded seals in other areas, have not been developed. Although a number of potential uses of multispecies models were identified, it was noted that the marine mammals are not included in models routinely used in multispecies management.

These workshops have illustrated the complexity of the interactions between seals and other marine resources. The research recommendations presented will improve our knowledge of the role of seals as apex predators in the marine ecosystems, and direct efforts to quantify predator - fishery interactions. The Working Group endorsed these recommendations.

6 POPULATION MODELS

The Working Group was unable to assess existing population models for harps and decide upon a standardised series of models at this meeting. However, it was agreed that a standardised set of population parameters be made available for assessing stocks discussed in the Working Group.

The population parameters that are required are listed in Table 2.

Table 2. Population parameters for (species) in (area).

Parameter	Year(s)	Mean value	c.v.	Method[1,5,6]	Reference
Females					
Sexual maturity[2]:					
Reproductive maturity[3]:					
Males					
Sexual maturity[4]:					
Fertility[5]:					
Mortality					
pups:					
subadults:					
adults:					
Population					
Pup production[6]:					
Total population:					
Trend in abundance:					
Age composition data					
breeding:					
moulting:					
other:					

[1] E= estimated from data; M= estimated from model/simulations; G= analogy ("guesstimate")
[2] Age at first ovulation
[3] Age at first parturition
[4] Age at first spermatogenesis
[5] O= ovulation rate; P(L)= (late) pregnancy rate
[6] Obtained by R= mark-recaptures; V= visual surveys; S= photographic surveys; I= survival index; A= adult counts

The Working Group **recommended** that a workshop be held during which a variety of population models are presented and their performance evaluated under different scenarios concerning the availability of data and the degree of uncertainty expected. Such a workshop could not be held before 1999. Specific details of the workshop should be discussed and agreed upon at the next meeting of the Working Group.

7 FUTURE ACTIVITIES OF THE WORKING GROUP

The Working Group noted the significant advancements in our knowledge of harp seal pup production in the White Sea and the population status of hooded seals in the Greenland Sea were made during this meeting. In the case of the White Sea, if some of the existing survey data were reanalysed and if a more appropriate population model were developed, then a population estimate and catch options could be calculated. Preliminary analyses of hooded seal pup production in the Greenland Sea were presented and the information is near the stage where it can be incorporated into a population model. Thus, a total population estimate and catch options for this stock are also possible. Considering the importance of these studies, the Working Group should meet during the fall of 1998 to complete this work. In the interim, members of the Group should ensure that the required data sets and related information are available for modelling prior to the meeting.

The Working Group recognizes that as more information becomes available on the various harp and hooded seal stocks there will be an increased need to standardize a suite of population models that can most effectively

accommodate the range and type of data collected. To accomplish this objective a modelling workshop involving Working Group members and outside experts should be convened in 1999.

8 RECOMMENDATIONS

The Working Group discussed future research priorities and **recommends** that:

1) With respect to the White/Barents Sea:

   a) pup production survey results be reanalysed taking into account discrepancies in methodologies identified by the Working Group;

   b) experiments be conducted to determine the appropriate survey methodology required to estimate pup production;

   c) the various parties conducting research in the White Sea combine their efforts to optimise their activities and ensure that surveys, sampling, and the assessments are completed successfully;

   d) tagging of harp seals in the White and Barents Seas should be continued, and mark-recapture studies, included testing of the underlying assumptions, should be conducted to provide independent estimates of pup production;

2) Current and historical estimates of the level and compositon of harp and hooded seal catches be obtained from the Canadian Arctic and Greenland;

3) All available age composition data and biological samples should be analysed and presented to the Working Group to allow assessment of biological parameters;

4) Studies on the diet of harp and hooded seals with concurrent estimates of possible prey abundance should be continued;

5) Radio- and/or satellite-tagging experiments should be continued to provide information on movements, activity patterns and bioenergetics of individual seals, particularly Greenland Sea harp seals and Northwest Atlantic hooded seals;

6) The importance of incorporating detailed catch at age data in the assessment models be investigated and, if significant, both samples collected in the past and new material should be used to improve and update the current estimates;

7) A workshop be held to evaluate population models under differing scenarios of data availablity and uncertainty.

9 OTHER BUSINESS

The Working Group honoured the memory of its member Dr Lev A. Popov, Russia, who passed away in January 1994. His contributions to our knowledge of harp and hooded seals were significant, and his diligence and enthusiasm were greatly appreciated by all of his colleagues.

10 ADOPTION OF REPORT

The report was adopted by the Working Group at 1800, 3 September 1997.

APPENDIX I

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* Can be used as alternatives

APPENDIX II

AGENDA

1. Opening Remarks
2. Meeting Arrangements
   - 2.1 Meeting Schedule
   - 2.2 Appointment of Rapporteur(s)
   - 2.3 Review of Terms of Reference
   - 2.4 Adoption of the Agenda
   - 2.5 Review of Documentation
3. Harp Seals (*Phoca groenlandica*)
   - 3.1 Stock identity, Distribution and Migrations
   - 3.2 The Greenland Sea Stock
     - 3.2.1 Information on recent catches and regulatory measures
     - 3.2.2 Current research
     - 3.2.3 Biological parameters
     - 3.2.4 Population assessment
     - 3.2.5 Catch options
   - 3.3 The White Sea and Barents Sea Stock
     - 3.3.1 Information on recent catches and regulatory measures
     - 3.3.2 Current research
     - 3.3.3 Biological parameter
     - 3.3.4 Population assessment
     - 3.3.5 Catch options
   - 3.4 The Northwest Atlantic Stock
     - 3.4.1 Information on recent catches and regulatory measures
     - 3.4.2 Current research
     - 3.4.3 Information on the state of the stock
4. Hooded Seals (*Cystophora cristata*)
   - 4.1 Stock identity, Distribution and Migrations
   - 4.2 The Greenland Sea Stock
     - 4.2.1 Information on recent catches and regulatory measures
     - 4.2.2 Current research
     - 4.2.3 Biological parameters
     - 4.2.4 Population assessment
     - 4.2.5 Catch options
   - 4.3 The Northwest Atlantic Stock
     - 4.3.1 Information on recent catches and regulatory measures
     - 4.3.2 Current research
     - 4.3.3 Information on the state of the stock
5. Ecology of Seal Stocks
   - 5.1 Changes in Biological Parameters Due to Environmental Changes
   - 5.2 Interactions Between Seals and Other Marine Resources
6. Population Models
7. Future Activities of the Working Group
8. Recommendations
9. Other Business
10. Adoption of Report

APPENDIX III

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APPENDIX IV

CATCHES OF HARP AND HOODED SEALS

INCLUDING CATCHES TAKEN ACCORDING TO SCIENTIFIC PERMITS

Table 1. Catches of **hooded seals** in the Greenland Sea ("West Ice"), 1946–1997[a], incl. catches for scientific purposes.

	Norwegian catches			Russian catches			Total catches		
Year	pups	1 year and older	total	pups	1 year and older	total	pups	1 year and older	total
1946–50	31152	10257	41409	-	-	-[b]	31152	10257	41409
1951–55	37207	17222	54429	-	-	[b]	37207	17222	54429
1956–60	26738	9601	36340	825	1063	1888[b]	27563	10664	38228
1961–65	27793	14074	41867	2143	2794	4938	29936	16868	46805
1966–70	21495	9769	31264	160	62	222	21655	9831	31486
1971	19572	10678	30250	-	-	-	19572	10678	30250
1972	16052	4164	20216	-	-	-	16052	4164	20216
1973	22455	3994	26449	-	-	-	22455	3994	26449
1974	16595	9800	26395	-	-	-	16595	9800	26395
1975	18273	7683	25956	632	607	1239	18905	8290	27195
1976	4632	2271	6903	199	194	393	4831	2465	7296
1977	11626	3744	15370	2572	891	3463	14198	4635	18833
1978	13899	2144	16043	2457	536	2993	16356	2680	19036
1979	16147	4115	20262	2064	1219	3283	18211	5334	23545
1980	8375	1393	9768	1066	399	1465	9441	1792	11233
1981	10569	1169	11738	167	169	336	10736	1338	12074
1982	11069	2382	13451	1524	862	2386	12593	3244	15837
1983	0	86	86	419	107	526	419	193	612
1984	99	483	582	-	-	-	99	483	582
1985	254	84	338	1632	149	1781	1886	233	2119
1986	2738	161	2899	1072	799	1871	3810	960	4770
1987	6221	1573	7794	2890	953	3843	9111	2526	11637
1988	4873	1276	6149[c]	2162	876	3038	7035	2152	9187
1989	34	147	181	-	-	-	34	147	181
1990	26	397	423	0	813	813	26	1210	1236
1991	0	352	352	458	1732	2190	458	2084	2542
1992	0	755	755	500	7538	8038	500	8293	8793
1993	0	384	384	-	-	-	0	384	384
1994	0	492	492	23	4229	4252	23	4721	4744
1995	368	565	933	-	-	-	368	565	933
1996	575	236	811	-	-	-	575	236	811
1997	2765	169	2934	-	-	-	2765	169	2934

[a] For the period 1946–1970 only 5-year averages are given.

[b] For 1955, 1956 and 1957 Soviet catches of harp and hooded seals reported at 3,900, 11,600 and 12,900, respectively (Sov. Rep. 1975). These catches are not included.

[c] Including 1048 pups and 435 adults caught by one ship which was lost.

Table 2. Catches of **harp seals** in the Greenland Sea ("West Ice"), 1946–1997[a], incl. catches for scientific purposes.

	Norwegian catches			Russian catches			Total catches		
Year	pups	1 year and older	total	pups	1 year and older	total	pups	1 year and older	total
1946–50	26606	9464	36070	-	-	-	26606	9464	36070
1951–55	30465	9125	39589	-	-	-[b]	30465	9125	39589
1956–60	18887	6171	25058	1148	1217	2366[b]	20035	7388	27424
1961–65	15477	3143	18620	2752	1898	4650	18229	5041	23270
1966–70	16817	1641	18459	1	47	48	16818	1688	18507
1971	11149	0	11149	-	-	-	11149	0	11149
1972	15100	82	15182	-	-	-	15100	82	15182
1973	11858	0	11858	-	-	-	11858	0	11858
1974	14628	74	14702	-	-	-	14628	74	14702
1975	3742	1080	4822	239	0	239	3981	1080	5061
1976	7019	5249	12268	253	34	287	7272	5283	12555
1977	13305	1541	14846	2000	252	2252	15305	1793	17098
1978	14424	57	14481	2000	0	2000	16424	57	16481
1979	11947	889	12836	2424	0	2424	14371	889	15260
1980	2336	7647	9983	3000	539	3539	5336	8186	13522
1981	8932	2850	11782	3693	0	3693	12625	2850	15475
1982	6602	3090	9692	1961	243	2204	8563	3333	11896
1983	742	2576	3318	4263	0	4263	5005	2576	7581
1984	199	1779	1978	-	-	-	199	1779	1978
1985	532	25	557	3	6	9	535	31	566
1986	15	6	21	4490	250	4740	4505	256	4761
1987	7961	3483	11444	-	3300	3300	7561	6783	14744
1988	4493	5170	9663[c]	7000	500	7500	11493	5670	17163
1989	37	4392	4429	-	-	-	37	4392	4429
1990	26	5482	5508	0	784	784	26	6266	6292
1991	0	4867	4867	500	1328	1828	500	6195	6695
1992	0	7750	7750	590	1293	1883	590	9043	9633
1993	0	3520	3520	-	-	-	0	3520	3520
1994	0	8121	8121	0	72	72	0	8193	8193
1995	317	7889	8206	-	-	-	317	7889	8206
1996	5649	778	6427	-	-	-	5649	778	6427
1997	1962	199	2161	-	-	-	1962	199	2161

[a] For the period 1946–1970 only 5-year averages are given.

[b] For 1955, 1956 and 1957 Soviet catches of harp and hooded seals reported at 3,900, 11,600 and 12,900, respectively (Sov. Rep. 1975). These catches are not included.

[c] Including 1431 pups and one adult caught by a ship which was lost.

Table 3. Norwegian **sealing effort** in the Greenland Sea ("West Ice"), 1946–1997[a].

Year	Number of trips/boats	Crew number Total	Crew number Average	Average duration of trips (days)	Average tonnage Gross	Average tonnage Net	Average Horse-power
1946–50	37	588	16	43	119	42	195
1951–55	45	760	17	40	140	49	277
1956–60	43	702	16	50	137	47	282
1961–65	40	652	16	47	140	48	337
1966–70	24	370	16	42	152	52	500
1971	18	242	13	23	154	51	548
1972	20	256	13	42	165	56	551
1973	16	202	13	37	164	55	526
1974	16	200	13	42	163	55	561
1975	15	188	13	39	163	54	573
1976	15	188	13	51	174	61	650
1977	13	156	12	43	174	61	642
1978	11	132	12	42	198	73	773
1979	10	130	13	46	224	84	910
1980	9	115	13	52	266	107	1034
1981	7	91	13	52	281	119	1070
1982	6	84	14	36	334	134	1348
1983	2	.	(10)	39	352	144	1325
1984	2	.	(10)	41	237	86	970
1985	1	11	11	37	178	72	940
1986	2	.	.	.	.	.	.
1987	5	.	.	.	.	.	.
1988	7(6)[b]	.	.	.	.	.	.
1989	3	.	.	.	.	.	.
1990	3	41	14	.	.	.	.
1991	2	26	13	.	.	.	.
1992	3	.	.	.	.	.	.
1993	2	.	.	.	.	.	.
1994	2	.	.	.	.	.	.
1995	2	.	.	.	.	.	.
1996	2	.	.	.	.	.	.
1997	1	.	.	.	.	.	.

[a] For the period 1946–1970 only 5-year averages are given.

[b] One ship lost.

Table 4. Soviet/Russian **sealing effort** in the Greenland Sea ("West Ice"), 1958–1997[a,b].

Year	Number of vessels	Average crew number	Average duration of trips (days)	Average tonnage		Average Horse power
				Gross	Net	
1958–60	6	23	22	200	.	.
1961–65	7	23	45	200	.	.
1966–	4	23	46	200	.	.
1967–74[c]	-	-	-	-	-	-
1975	1	.	45	.	.	.
1976	2	.	24	.	.	.
1977	3	68	16	1971	597	3300
1978	3	.	22	.	.	.
1979	2	.	24	.	.	.
1980	2	.	21	.	.	.
1981	2	.	17	.	.	.
1982	2	.	22	.	.	.
1983	2	.	.	.	.	.
1984	-	-	-	-	-	-
1985	2	.	16	.	.	.
1986	2	.	(11)	.	.	.
1987	2	.	(23)	.	.	.
1988	3	.	.	.	.	.
1989	-	-	-	-	-	-
1990	1	.	.	.	.	.
1991	1	.	.	.	.	.
1992	2	.	.	.	.	.
1993	-	-	-	-	-	-
1993	1	.	.	.	.	.
1994	1	.	.	.	.	.
1995–97[c]	-	-	-	-	-	-

[a] Information extracted from the Soviet reports to the Norwegian-Soviet Sealing Commission.

[b] For the period 1958–1965 only average are given.

[c] Soviet/Russian vessels did not participate in the hunt in 1967–1974 and after 1994.

Table 5. Catches of **harp seals** in the White and Barents Seas ("East Ice"), 1946–1997[a].

	Norwegian catches			Russian catches			Total catches		
Year	pups	1 year and older	total	pups	1 year and older	total	pups	1 year and older	total
1946–50			25057	90031	55285	145316			170373
1951–55			19590	59190	65463	124651			144241
1956–60	2278	14093	15777	58824	34605	93549	61102	48698	109326
1961–65	2456	8311	10761	46293	22875	69168	48749	31186	79929
1966–70			12783	21186	410	21596			34379
1971	7028	1596	8624	26666	1002	27668	33694	2598	36292
1972	4229	8209	12438	30635	500	31135	34864	8709	43573
1973	5657	6661	12318	29950	813	30763	35607	7474	43081
1974	2323	5054	7377	29006	500	29506	31329	5554	36883
1975	2255	8692	10947	29000	500	29500	31255	9192	40447
1976	6742	6375	13117	29050	498	29548	35792	6873	42665
1977	3429	2783	6212[c]	34007	1488	35495	37436	4271	41707
1978	1693	3109	4802	30548	994	31542	32341	4103	36344
1979	1326	12205	13531	34000	1000	35000	35326	13205	48531
1980	13894	1308	15202	34500	2000	36500	48394	3308	51702
1981	2304	15161	17465[d]	39700	3866	43566	42004	19027	61031
1982	6090	11366	17456	48504	10000	58504	54594	21366	75960
1983	431	17658	18089	54000	10000	64000	54431	27658	82089
1984	2091	6785	8876	58153	6942	65095	60244	13727	73971
1985	348	18659	19007	52000	9043	61043	52348	27702	80050
1986	12859	6158	19017	53000	8132	61132	65859	14290	80149
1987	12	18988	19000	42400	3397	45797	42412	22385	64797
1988	18	16580	16598	51990	2501	54401	51918	19081	70999
1989	0	9413	9413	30989	2475	33464	30989	11888	42877
1990	0	9522	9522	30500	1957	32457	30500	11479	41979
1991	0	9500	9500	30500	1980	32480	30500	11480	41980
1992	0	5571	5571	28351	2739	31090	28351	8310	36661
1993	0	8758[e]	8758	31000	500	31500	31000	9258	40258
1994	0	9500	9500	30500	2000	32500	30500	11500	42000
1995	260	6582	6842	29144	500	29644	29404	7082	36486
1996	2910	6611	9521	31000	528	31528	33910	7139	41049
1997	15	5004	5019	31319	61	31380	31334	5065	36399

[a] For the period 1946–1970 only 5-year averages are given.

[b] Incidental catches of harp seals in fishing gear on Norwegian and Murman coasts are not included (see Table 6).

[c] Approx. 1300 harp seals (unspecified age) caught by one ship lost are not included.

[d] An additional 250–300 animals were shot but lost as they drifted into Soviet territorial waters.

[e] Included 717 seals caught to the south of Spitsbergen, east of 14° E, by one ship which mainly operated in the Greenland Sea.

Table 6. Incidental catches and death of **harp seals** at the Norwegian and Murman coasts[1].

Year	Norwegian coast	Murman coast	Total
1978	.	.	.
1979	2023	1114	3137
1980	3311		
1981	2013		
1982	517		
1983	855		
1984	1236		
1985	1225		
1986	4409		
1987	56222		
1988	21538		
1989	314		
1990	368		
1991–1994	.		
1995	10616		
1996	.		
1997	.		

[1] Norwegian data are recorded catches, since 1981 recorded for compensation under regulations for damage to fishing gear. No compensation was paid in 1991–1994 and after 1995.

Table 7. Catches of **moulting hooded seals** in the Denmark Strait, 1945–1978.

Year	Norway sealing	Greenland sealing[a]	Norway scient. sampling
1945	3275	-	-
1946	17767	-	-
1947	16080	-	-
1948	16170	-	-
1949	1494	-	-
1950	17742	-	-
1951	47607	-	-
1952	16910	-	-
1953	2907	-	-
1954	18291	-	-
1955	10230	-	-
1956	12840	-	-
1957	21425	-	-
1958	14950	-	-
1959	6480	414	-
1960	7930	0[b]	-
1961	-	773	-
1962	-	967	-
1963	-	813	-
1964	-	360	-
1965	-	-	-
1966	-	782	-
1967	-	358	-
1968	-	-	-
1969	-	-	-
1970	-	-	797
1971	-	-	-
1972	-	-	869
1973	-	-	-
1974	-	-	1201
1975	-	-	-
1976	-	-	323
1977	-	-	-
1978	-	-	1201

[a] Conducted by **KGH** (Royal Greenland Trade Department) on behalf of the local inhabitants of Ammassalik, Southeast Greenland.

[b] The vessel was lost 23 June on its first trip that year; *previous information* on a catch of 773 seals is thus in error (probably confused with the 1961-catch).

Table 8. Catches of **hooded seals** in West and East Greenland, 1954–1994.

Year	West Greenland N	West Greenland NW-S	West Greenland TOTAL	East Greenland SE	East Greenland KGH[c]	East Greenland NE	East Greenland TOTAL	Total Greenland
1954	-	1,097	1,097	201	-	-	201	1,298
1955	1	971	972	343	-	1	344	1,316
1956	-	593	593	261	-	3	264	857
1957	5	792	797	410	-	2	412	1,209
1958	-	846	846	361	-	4	365	1,211
1959	2	778	780	312	414	8	734	1,514
1960	3	962	965	327	-	4	331	1,296
1961	14	659	673	346	803	2	1,151	1,824
1962	3	542	545	324	988	2	1,314	1,859
1963	7	885	892	314	813	2	1,129	2,021
1964	3	2,182	2,185	550	366	2	918	3,103
1965	3	1,819	1,822	308	-	2	310	2,132
1966	8	1,813	1,821	304	748	-	1,052	2,873
1967	18	1,590	1,608	357	371	1	729	2,337
1968	12	1,380	1,392	640	20	1	661	2,053
1969	5	1,817	1,822	410	-	1	411	2,233
1970	3	1,409	1,412	704	-	9	713	2,125
1971	2	1,632	1,634	744	-	-	744	2,378
1972	1	2,382	2,383	1,825	-	2	1,827	4,210
1973	16	2,638	2,654	673	-	4	677	3,331
1974	61[a]	2,740	2,801	1,205	-	13	1,218	4,019
1975	143[a]	3,536	3,679	1,027	-	58[a]	1,085	4,764
1976	108[a]	4,122	4,230	811	-	22[a]	833	5,063
1977	102	3,649	3,751	2,226	-	32[a]	2,258	6,009
1978	73	3,562	3,635	2,752	-	17	2,769	6,404
1979	152[a]	3,460	3,612	2,289	-	15	2,304	5,916
1980	113[a]	3,666	3,779	2,616	-	21	2,637	6,416
1981	101[a]	3,644	3,745	2,424	-	28[a]	2,452	6,197
1982	128[a]	4,270	4,398	2,035	-	16[a]	2,051	6,449
1983	79[a]	4,076	4,155	1,321	-	9[a]	1,330	5,485
1984	79	3,285	3,364	1,328	-	17	1,345	4,709
1985	51	3,137	3,188	3,689	-	6	3,695	6,883
1986	...	2,796[b]	2,796[b]	3,050[b]	-	-[b]	3,050[b]	5,846[b]
1987	...	2,333[b]	2,333[b]	2,472[b]	-	3[b]	2,475[b]	4,808[b]
1988–92[d]								
1993[e]	12	4,918	4,930	1,944	-	32	1,976	6,906
1994[e]	201	4,353	4,554	2,745	-	31	2,776	7,330

[a] Figures include estimates for non-reported catches for this region only in these years.

[b] Provisional figures: do not include estimates for non-reported catches as for the previous years.

[c] Royal Greenland Trade Department special vessel catch expeditions in the Denmark Strait, 1959–68.

[d] For 1988 to 1992 catch statistics are not available.

[e] Preliminary estimates according to a new system of collecting catch statistics.

Table 9a. Catches of **harp seals** in Greenland. 1954–1987 (List-of-Game), and 1993–1995 (Piniarneq), and % adults[a] according to the hunters' reports.

	West Greenland		South East Greenland		North East Greenland		All Greenland
Year	Catch numbers	% adults	Catch numbers	% adults	Catch numbers	% adults	Catch numbers
1954	18,912		475		32		19.419
1955	15,445		178		45		15.668
1956	10,883		180		5		11.068
1957	12,817		133		40		12.990
1958	16,705		360		30		17.095
1959	8,844		168		7		9.019
1960	15,979		350		16		16.244
1961	11,886		219		13		12.118
1962	8,394		211		10		8.615
1963	10,003	21	215	28	20	50	10.238
1964	9,140	26	125	40	7	86	9.272
1965	9,251	25	76	65	2	100	9.329
1966	7,029	29	55	55	6		7.090
1967	4,215	38	54	35	10		4.279
1968	7,026	30	180	47	4		7.210
1969	6,383	21	110	62	9		6.502
1970	6,178	26	182	70	15	100	6.375
1971	5,540	24	63	48	5		5.608
1972	5,952	16	84	48	6	100	6.042
1973	9,162	19	100	20	38	79	9.300
1974	7,073	21	144	29	27	95	7.244
1975	5,953	13	125	20	68	72	6.146
1976	7,787	12	260	48	27	55	8.074
1977	9,938	15	72	16	21	81	10,031
1978	10,540	16	408	14	30	36	10,978
1979	12,774	20	171	19	18	25	12.963
1980	12,270	17	308	14	45		12.623
1981	13,605	21	427	15	49		14,081
1982	17,244	16	267	20	50	60	17,561
1983	18,739	19	357	56	57	30	19,153
1984	17,667	16	525	19	61		18,253
1985	18,445	2	534	0	56	52	19,035
1986	13,932[b]	10	533[b]	18	37[b]	65	14,502[b]
1987	16,053[b]	21	1060[b]	24	15[b]	60	17,128[b]
1988							
1989							
1990	For 1988 to 1992 comparable catch statistics are not available.						
1991							
1992							
1993	52,526	52	1,040	35	76	62	53,642
1994	54,002	51	660	36	78	63	54,996
1995	59,766	50	881	41	96	53	60,743

[a] Seals exhibiting some form of a harp.

[b] These provisional figures do not include estimates for non-reported catches as for the previous years.

Table 9b. Estimated catches of **harp seals** in Greenland, 1975–1987 and 1993–1995. Figures in bold are non-corrected figures from Table 9a. Estimates are from Rosing-Asvid (this meeting, SEA-86)

Year	West Greenland	South East Greenland	North East Greenland	Total Greenland
1975	6,689	**125**	**68**	6,882
1976	11,826	**260**	50	12,136
1977	12,830	**72**	50	12,952
1978	16,434	**408**	50	16,892
1979	17,459	**171**	50	17,680
1980	15,101	**308**	**45**	15,464
1981	22,760	**427**	**49**	23,236
1982	26,793	**267**	**50**	27,110
1983	24,606	**357**	**57**	25,020
1984	25,566	**525**	**61**	26,152
1985	20,518	**534**	**56**	21,108
1986	25,832	**533**[a]	50	26,415
1987	37,329	**1060**[a]	50	38,439
1993	**52,526**	1,335	**76**	53,937
1994	58,811	1,746	**78**	60,635
1995	65,533	1,529	**96**	67,158

[a] Provisional figures; do not include estimates for non-reported catches.

Table 10. **Harp seal** catches, including research catches, off Newfoundland and in the Gulf of St. Lawrence, Canada ("Gulf" and "Front"), 1946–1997[a,b].

Year	Large Vessel Catch				Landsmen Catch				Total Catches			
	Pups	1+	Unk	Total	Pups	1+	Unk	Total	Pups	1+	Unk	Total
1946-50	108256	53763	0	162019	44724	11232	0	55957	152981	64995	0	217976
1951-55	184857	87576	0	272433	43542	10697	0	54240	228399	98274	0	326673
1956-50	175351	89617	0	264969	33227	7848	0	41075	208578	97466	0	306044
1961-65	171643	52776	0	224420	47450	13293	0	60743	219093	66069	0	285163
1966-70	194819	40444	0	235263	32524	11633	0	44157	227343	52077	0	279420
1971	169426	14343	0	183769	41153	6044	0	47197	210579	20387	0	230966
1972	104109	1646	0	105755	12701	11427	0	24128	116810	13073	0	129883
1973	63369	15081	0	78450	34966	10416	0	45382	98335	25497	0	123832
1974	85387	21828	0	107215	29438	10982	0	40420	114825	32810	0	147635
1975	109832	10992	0	120824	30806	22733	0	53539	140638	33725	0	174363
1976	93939	4576	0	98515	38146	28341	0	66487	132085	32917	0	165002
1977	92904	2048	0	94952	34078	26113	0	60191	126982	28161	0	155143
1978	63669	3523	0	67192	52521	42010	0	94531	116190	45533	0	161723
1979	96926	449	0	97375	35532	27634	0	63166	132458	28083	0	160541
1980	91577	1563	0	93140	40844	35542	0	76386	132421	37105	0	169526
1981[d]	89049	1211	0	90260	89345	22564	0	111909	178394	23775	0	202169
1982	100568	1655	0	102223	44706	19810	0	64516	145274	21465	0	166739
1983	9529	1021	0	10550	40529	6810	0	47339	50058	7831	0	57889
1984	95	549	0	644[c]	23745	6528	0	30273	23840	7077	0	30917
1985	0	1	0	1[e]	13334	5700	0	19034	13334	5701	0	19035
1986	0	0	0	0	21888	4046	0	25934	21888	4046	0	25934
1987	2671	90	2	2763	30986	10266	20	41272	33657	10356	22	44035
1988	0	0	0	0	66950	13493	13603	94046	66950	13493	13603	94046
1989	0	0	0	0	53879	5504	5691	65074	53879	5504	5691	65074
1990	48	44	0	92[e]	33144	22087	2903	58134	33192	22131	2903	58226
1991	0	0	0	0	42379	10186	0	52565	42379	10186	0	52565
1992	94	792	0	886[c]	43767	23956	0	67723	43861	24748	0	68609
1993	8	111	0	119[c]	16393	10491	0	26884	16401	10602	0	27003
1994	43	127	0	170[c]	25180	36004	0	61184	25223	36131	0	61354
1995	4	225	0	229[c]	33682	31239	470	65391	33686	31464	470	65620
1996	0	134	0	134[c]	184423	56660	1145	242228	184423	56794	1145	242362
1997[f]	0	7	0	7[e]	220476	40560	0	261036	220476	40567	0	261043

[a] For the period 1946-1970 only 5-years averages are given.
[b] All values are from NAFO except where noted.
[c] Landsmen values include catches by small vessels (< 150 gr tons) and aircraft.
[d] NAFO values revised to include complete Quebec catch (Bowen, W.D. 1982)
[e] Large vessel catches represent research catches and may differ from NAFO values
[f] Preliminary estimates

Table 11. Published values for **harp seal** catches in the Canadian Arctic, 1952–1984.

Year	Bowen[1]			D.E.S.[2]	Roff & Bowen[3]			NAFO[4]	Stewart et al.[5]		
	0	1+	Total	Total	0	1+	Total		N Que	Baffin	N Lab
1952	60	1724	1784								
1953	60	1724	1784								
1954	60	1724	1784								
1955	60	1724	1784								
1956	60	1724	1784								
1957	60	1724	1784								
1958	60	1724	1784								
1959	60	1724	1784								
1960	60	1724	1784								
1961	60	1724	1784								
1962	60	1724	1784								
1963	60	1724	1784								
1964	60	1724	1784								
1965	60	1724	1784								
1966	60	1724	1784								
1967	60	1724	1784								
1968	60	1724	1784								
1969	60	1724	1784								
1970	60	1724	1784								
1971	60	1724	1784								
1972	60	1724	1784								
1973	60	1724	1784								
1974	60	1724	1784	1117							
1975	60	1724	1784	2513							
1976	60	1724	1784	2017					272		
1977	60	1724	1784	1508				1508	306		
1978	60	1724	1784		72	2057	2129	2129	44		
1979	60	1724	1784		128	3492	3620	3707	87		
1980	60	1724	1784		215	6135	6350	6459	52		2062
1981					158	4514	4672	4672		6263	20775
1982					166	4715	4881	4268		5849	1226
1983								1287		2433	86
1984											288

[1]Bowen, W. D. 1982. Age structure of Northwest Atlantic harp seal catches, 1952-80. *NAFO Sci. Coun. Studies*, **3**: 53-65. Mean catch of 1768 for years 1962-1971 from Smith and Taylor (1977) and values of years 1974-1977 reported by Sergeant.

[2]Sergeant (pers. comm.) as cited in Bowen (1982).

[3]Roff, D. A. and W. D. Bowen. 1986. Further analysis of population trends in the Northwest Atlantic harp seal (*Phoca groenlandica*) from 1967 to 1985. *Can. J. Fish. Aquat. Sci.*, **43**: 553-564.

[4]Anon. 1985. Provisional report of the Scientific Council. NAFO SCS Doc. 85/I/2. Values include catches in the Northwest Territories and northern Quebec.

[5]Stewart, R. E. A., P. Richards, M. C. S. Kingsley and J. J. Houston. 1986. Seals and sealing in Canada's northern and Arctic regions. *Fish. Aquat. Sci. Tech. Rep.*, No. 1463.

Table 12. **Hooded seal** catches, including research catches, off Newfoundland and in the Gulf of St. Lawrence, Canada ("Gulf" and "Front"), 1946–1997[a,b].

Year	Large Vessel Catches				Landsmaen Catches[c]				Total Catches			
	Pups	1+	Unk	Total	Pups	1+	Unk	Total	Pups	1+	Unk	Total
1946-50	4029	2221	0	6249	429	184	0	612	4457	2405	0	6862
1951-55	3948	1373	0	5321	494	157	0	651	4442	1530	0	5972
1956-60	3641	2634	0	6275	106	70	0	176	3747	2704	0	6451
1961-65	2567	1756	0	4323	521	199	0	720	3088	1955	0	5043
1966-70	7483	5220	0	12702	613	211	24	848	8096	5430	24	13551
1971	7987	6875	0	14862	54	30	0	84	8041	6905	0	14946
1972	6820	5636	0	12456	108	36	0	144	6928	5672	0	12600
1973	4499	1930	0	6429	103	35	0	138	4602	1965	0	6567
1974	5984	3990	0	9974	7	18	0	25	5991	4008	0	9999
1975	7459	7805	0	15264	187	160	0	347	7646	7965	0	15611
1976	6065	5718	0	11783	475	127	0	602	6540	5845	0	12385
1977	7967	2922	0	10889	1003	201	0	1204	8970	3123	0	12093
1978	7730	2029	0	9759	236	509	0	745	7966	2538	0	10504
1979	11817	2876	0	14693	131	301	0	432	11948	3177	0	15125
1980	9712	1547	0	11259	1441	416	0	1857	11153	1963	0	13116
1981	7372	1897	0	9269	3289	1118	0	4407	10661	3015	0	13676
1982	4899	1987	0	6886	2858	649	0	3507	7757	2636	0	10393
1983	0	0	0	0	0	128	0	128	0	128	0	128
1984	206	187	0	338[d]	0	56	0	56	206	243	0	449
1985	215	220	0	435[d]	5	344	0	349	220	564	0	784
1986	0	0	0	0	21	12	0	33	21	12	0	33
1987	124	4	250	378	1197	280	0	1477	1321	284	250	1855
1988	0	0	0	0	828	80	0	908	828	80	0	908
1989	0	0	0	0	102	260	5	367	102	260	5	367
1990	41	53	0	94[d]	0	0	636[e]	636	41	53	636	730
1991	0	14	0	14[d]	0	0	6411[e]	6411	0	14	6411	6425
1992	35	60	0	95[d]	0	0	119[e]	119	35	60	119	214
1993	0	19	0	19[d]	0	0	19[e]	19	0	19	19	38
1994	19	53	0	72[d]	0	0	149[e]	149	19	53	149	221
1995	0	0	0	0	0	0	857[e]	857	0	0	857[e]	857
1996	0	0	0	0	0	0	25754[e]	25754	0	0	25754[e]	25754
1997[e]	0	0	0	0	0	0	7058[e]	7058	0	0	7058[e]	7058

[a] For the period 1946–1970 only 5-years averages are given.
[b] All values are from NAFO except where noted.
[c] Landsmen values include catches by small vessels (< 150 gr tons) and aircraft.
[d] Large vessel catches represent research catches and may differ from NAFO values.
[e] Statistics no longer split by age
[f] Preliminary estimates

APPENDIX V

SUMMARIES OF SEALING REGULATIONS

Table 3a. Major management measures implemented for harp seals in Canadian waters, 1960–1997.

Year	Management Measure
1961	Opening and closing dates set for the Gulf of the St. Lawrence and Front areas.
1964	First licensing of sealing vessels and aircraft. Quota of 50,000 set for southern Gulf (effective 1965).
1965	Prohibition on killing adult seals in breeding or nursery areas. Introduction of licensing of sealers. Introduction of regulations defining killing methods.
1966	Amendments to licensing. Gulf quota areas extended. Rigid definition of killing methods.
1971	TAC for large vessels set at 200,000 and an allowance of 45,000 for landsmen.
1972 - 1975	TAC reduced to 150,000, including 120,000 for large vessel and 30,000 (unregulated) for landsmen. Large vessel hunt in the Gulf prohibited.
1976	TAC was reduced to 127,000.
1977	TAC increased to 170,000 for Canadian waters, including an allowance of 10,000 for northern native peoples and a quota of 63,000 for landsmen (includes various suballocations throughout the Gulf of St. Lawrence and northeastern Newfoundland). Adults limited to 5% of total large vessel catch.
1978–1979	TAC held at 170,000 for Canadian waters. An additional allowance of 10,000 for the northern native peoples (mainly Greenland).
1980	TAC remained at 170,000 for Canadian waters including an allowance of 1,800 for the Canadian Arctic . Greenland was allocated additional 10,000.
1981	TAC remained at 170,000 for Canadian waters including 1,800 for the Canadian Arctic. An additional allowance of 13,000 for Greenland.
1982–1987	TAC increased to 186,000 for Canadian waters including increased allowance to northern native people of 11,000. Greenland catch anticipated at 13,000.
1987	Change in Seal Management Policy to prohibit the commercial hunting of whitecoats and hunting from large (>65 ft) vessels (effective 1988). Changes implemented by a condition of licence.
1992	First Seal Management Plan implemented.
1993	Seal Protection Regulations updated and incorporated in the Marine Mammal Regulations. The commercial hunt of whitecoats now prohibited under the Regulations. Netting of seals south of 54°N prohibited. Other changes to define killing methods, control interference with the hunt and remove old restrictions
1995	Personal sealing licences allowed. TAC remained at 186,000 including personal catches. Quota divided among Gulf, Front and unallocated reserve.
1996	TAC increased to 250,000 including allocations of 2,000 for personal use and 2,000 for Canadian Arctic.
1997	TAC increased to 275,000 for Canadian waters.

Table 3b. Major management measures implemented for hooded seals in Canadian waters (1960–1997).

Year	Management Measure
1964	Hunting of hooded seals banned in the Gulf area (below 50°N), effective 1965.
1966	ICNAF assumed responsibility for management advice for northwest Atlantic .
1968	Open season defined (12 March–15 April).
1974–1975	TAC set at 15,000 for Canadian waters. Opening and closing dates set (20 March–24 April).
1976	TAC held at 15.000 for Canadian waters. Opening delayed to 22 March. Shooting banned between 23:00 and 10:00 GMT from opening until 31 March and between 24:00 and 09:00 GMT thereafter (to limit loss of wounded animals).
1977	TAC maintained at 15,000 for Canadian waters. Shooting of animals in water prohibited (to reduce loss due to sinking). Number of adult females limited to 10% of total catch.
1978	TAC remained at 15,000 for Canadian waters. Limited number of adult females to 7.5% of total catch.
1979–1982	TAC maintained at 15,000. Catch of adult females reduced to 5% of total catch.
1983	TAC reduced to 12,000 for Canadian waters. Previous conservation measures retained.
1984–1990	TAC reduced to 2,340 for Canadian waters.
1987	Change in Seal Management Policy to prohibit the commercial hunting of bluebacks and hunting from large (>65 ft) vessels (effective 1988). Changes implemented by a condition of licence.
1991–1992	TAC raised to 15,000
1992	First Seal Management Plan implemented.
1993	TAC reduced to 8,000. Seal Protection Regulations updated and incorporated in the Marine Mammal Regulations. The commercial hunt of bluebacks now prohibited under the Regulations.
1994–1997	TAC held at 8,000.
1995	Personal sealing licences allowed.