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JOINT ICES/NAFO WORKING GROUP ON HARP AND HOODED SEALS
TROMSØ, NORWAY

29 September-02 October 1998

by

ICES/NAFO Working Group

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Advisory Committee on Fishery Management **ICES CM 1999/ACFM:7**

REPORT OF THE

JOINT ICES/NAFO WORKING GROUP ON HARP AND HOODED SEALS

Tromsø, Norway

29 September–2 October 1998

International Council for the Exploration of the Sea

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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 organisations. Contracting Parties to either organisation or regulatory commissions who might desire advice on harp and/or hooded seals in a particular geographical area must refer their request to the organisation (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).

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). The Working Group met again 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 from NAMMCO in May 1995, and on questions that arose from its 1993 meeting, the Joint Working Group met in August/September 1997 to provide assessment advice on harp seals in the White Sea and Barents Sea, and harp and hooded seals in the Greenland Sea; to review existing population models for harp seals in order to standardise the methodology used to estimate numbers at age; to 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 (ICES CM 1998/Assess:3).

The Working Group was unable to deal with the entire request, and decided to meet during the fall of 1998 to complete the work. The terms of references formulated by ACFM in response to this were:

The Joint ICES/NAFO Working Group on Harp and Hooded Seals [WGHARP] (Chairman: Dr. G. Stenson, Canada) will meet in Tromsø, Norway from 29 September to 2 October 1998 to:

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

b) assess the sustainable yield at present stock sizes and provide catch options for these two stocks.

The above terms of reference are set up to provide ACFM with the information required to respond to the request for advice from NAMMCO.

The Working Group agreed that available scientific information on other stocks should be reviewed if they were relevant.

2 MEETING ARRANGEMENTS

The Working Group, chaired by G. Stenson, and comprised of scientists from Canada, Norway, Russia, and USA met at the Norwegian Institute of Fisheries and Aquaculture in Tromsø, Norway from 29 September to 2 October 1998. 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

No new data were available on this issue. However, the Working Group was informed that there were plans in Norway and Canada to deploy satellite tags on harp seals during the coming year in the Greenland Sea and Northwest Atlantic, respectively.

3.2 The Greenland Sea Stock

3.2.1 Information on recent catches and regulatory measures

Detailed information on Norwegian catches of harp seals in the Greenland Sea pack-ice in 1998 was not available to the Working Group, but was reported to be well below the allocated quota of 13,100 animals one year of age and older (1+). Russia has not participated since 1994. As in 1997, the Norwegian quota could be taken as 1+ animals or as weaned pups, one 1+ animal considered equal to two pups (Appendix V, Table 1).

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

A Norwegian study, initiated to look at possible changes in age at sexual maturity for female harp seals in the West Ice from the 1960s until present, is in progress. Sampling of the pups (see Haug *et al.*, 1996) and 1+ animals taken in commercial catches was planned on one of the vessels, but had to be cancelled due to technical problems on the allocated ship. No new tagging of West Ice harp seal pups have been conducted. Some animals were taken for scientific purposes (studies of physiology and pollutants) during a research survey in April.

Using data collected by Russian scientists in the West Ice in previous years, life history parameters (growth, age at maturity, fecundity, ovulation time) of the females are being studied in a joint Norwegian-Russian project.

3.2.3 Biological parameters

No new data on biological parameters were presented at this meeting. The Working Group was informed, however, that relevant biological material has been collected by Russian scientists over the past years. Some of these material (e.g., life history parameter data on males) 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.

3.2.4 Population assessments

No current estimate of pup production for this stock is available. However, updated pup production estimates for the period 1977–1991 were provided to the Working Group at its last meeting (Øien, 1997a, ICES CM 1998/Assess:3). The estimated pup production in 1991 was 67,300 (95% C.I. 56,400–78,113), which is about 10% higher than the mean estimate used in the last assessment carried out in 1993 (CM 1994/Assess:5). The Working Group could not point to any major event that could possibly affect the Greenland Sea harp seal stock adversely since the 1993 assessment, and therefore, based its best

estimate for pup production on the mark-recapture data.

The total population of harp seals in the Greenland Sea during 1998 was estimated using the model described in Skaug and Øien (this meeting, SEA-98; Ulltang 1989a; see below) and the 1991 pup production estimate of 67,300 (ICES CM 1998/Assess:3). Natural mortality (M_{1+}) was varied between 0.09 and 0.11, a range similar to that seen in other harp seal stocks, while $M_0 = M_{1+}$ (Anon. 1986)

	Numbers		
M_{1+}	0	1+	Total
0.09	97,000	456,000	549,000
0.1	85,000	416,000	501,000
0.11	79,000	379,000	458,000

Table 1. Estimated 1998 abundance of harp seals in the Greenland Sea assuming 1991 pup production of 67,300 (ICES CM 1998/Assess:3)

3.2.5 Catch options

Although no new estimates were available for pup production in this stock, the Working Group felt that it would be useful to estimate catch options based upon the revised 1991 pup production estimates and the 95% confidence intervals (ICES CM 1998/Assess:3). The model used to determine the population dynamics is described in Ulltang (1989a). Inputs to the model, described in Skaug and Øien (this meeting, SEA-98) include 1991 pup production, catches (number of caught pups and 1+ animals) for the period 1946 to 1998 and estimates of biological parameters:

Mortality:	$M_0 = 3M_{1+}$
Proportion Mature	p0,p1,...,p13+
Pregnancy rate	f

The 1946 population size was found by extrapolating backwards in time the population trajectory which interpolates the 1991 pup production estimate.

The constant exploitation rates that stabilize the population size are based on Equation (3) in Ulltang (1989b). The exploitation rates, u_0 and u_{1+}, are the proportions of pups and 1+ animals removed annually. Two options were calculated. In the first, only 1+ animals are taken ($u_0 = 0$; i.e. no catch of pups) and u_{1+} calculated under the requirement that the size of the population shall stabilize in the future. In the second, only pups are harvested (i.e. $u_{1+} = 0$) and u_0 calculated under the same requirement as the first.

Biological parameters used (from Ulltang 1989a) were the same as those accepted by the Working Group in its previous assessment (ICES CM 1994/Assess:5; Table 2):

Mortality	$M_{1+} = 0.11$ $M_0 = 0.33$			
Proportion Mature	$p_4 = 0$	$p_5 = 0.1$	$p_6 = 0.5$	$p_7 = 1.0$
Pregnancy rate	f = 0.94			

Table 2. Biological parameters used to estimate population size and catch options for Greenland Sea harp seals.

These parameters result in a population trajectory with a slightly increasing pup production over the period 1977–1991. This is consistent with the revised pup production estimates for this period presented in Øien (1997a) and ICES CM 1998/Assess:3. Extrapolating this model to 1998 assumes that this slight increase in population size continues over the period 1991–1998.

Table 3, taken from Skaug and Øien (this meeting, SEA-98), presents the catch options and stock sizes for 1999 and 2009, given a 1991 pup production estimate ($N_{1991,0}$) of 67,000 with upper and lower 95% confidence limits of 78,000 and 56,000, respectively:

Catch	Exploit. rate		1999 catch		1999 Pop. Size		2009 catch		2009 Pop. size	
Option	u_0	u_{1+}	Pups	1+	Pups	1+	Pups	1+	Pups	1+
$N_{1991,0}$ = 56,000										
1+	0	.046	0	14200	64100	308400	0	14200	62100	307400
Pups	.443	0	29800	0	67200	300800	33300	0	75100	291600
$N_{1991,0}$ = 67,000										
1+	0	.046	0	17500	78900	380800	0	17500	76800	380000
Pups	.443	0	36700	0	82700	371400	41200	0	92900	360400
$N_{1991,0}$ = 78,000										
1+	0	.046	0	20900	93800	453200	0	20800	91500	452500
Pups	.443	0	43600	0	98300	442000	49100	0	110700	429300

Table 3. Catch options for harp seals in the Greenland Sea under different assumptions of starting pup production and age of catch.

The Working Group noted that the estimates of pup abundance stabilise fairly quickly (approximately 15 years) while adult numbers continue to decline slowly for some time. Given this trend in abundance, lack of current data on reproductive rates and the lack of current pup production estimates for this stock, caution should be used when considering these catch estimates.

3.3 The White Sea and Barents Sea Stock

3.3.1 Information on 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, and in Golikov & Potelov (this meeting, SEA-95). Preliminary estimates of the combined catches in 1998 were 14,202 animals, of which 13,365 were pups. This is considerably lower than the 1989-1997 level, which ranged between 36,399-42,877. It was noted that Russian catches of age 1+ seals during 1988-1998 had been selected by scientific sampling protocols.

The total quotas during 1998 remained the same during 1989-1997 (40,000 animals). Low catches in 1998 as compared to the quota were due to two factors. Low Russian catches were a result of their difficulty in obtaining funds to pay for helicopter and ship support. Norwegian catches were low because ice movement during the period was insufficient to transport seals into international waters where they would be harvested. Unusual high (but quantitatively unrecorded) mortality of beaters were observed in the White Sea in May/June 1998, possibly due to the unusual ice conditions (Golikov & Potelov, this meeting, SEA-95). Available information on recent sealing regulations for the White and Barents Seas is summarised in Appendix V, Table 2.

3.3.2 Current research

Norwegian studies of summer feeding ecology of seals taken for scientific purposes in the northern Barents Sea have been conducted (Nilssen *et al.*, 1998). Furthermore, Norwegian researchers continue to analyse morphometric and age-related data collected in previous years. The lack of animals captured during 1998 will result in little additional information on pups, although some data on 1+ seals were collected (Nilssen and Lindstrøm, 1998). Invading seals, reported to be 3575, were not sampled during 1998.

Analysis of 1995-97 data collected from satellite tags deployed on seals as part of a joint Norway-Russian research program, continues. No tags were deployed during 1998.

Russian research in 1998 was directed towards improving assessment techniques. Results from a 1997 aerial pup survey presented at the 1997 working group meeting (Potelov *et al.*, 1997) were reanalysed using SURFER to calculate isolines

(Potelov *et al*., this meeting, SEA-94). An experimental aerial photographic survey for pups was conducted in March 1998 to compare results of traditional strip transect and isoline estimation techniques (Potelov *et al*., this meeting, SEA-93). Finally, a separate, complete aerial survey of harp seal pups and 1+ animals was conducted during 7-16 March 1998. This survey included the use of a variety of photographic techniques, development of correction factors, and estimation of the temporal distribution of births, i.e. whelping ogive (Chernook *et al*., this meeting, SEA-92).

3.3.3 Biological parameters

Age distribution in Russian catches of moulting harp seals was presented (Potelov, this meeting, SEA-96). These data reflect two separate sampling regimes: 1977-87 which was obtained from the commercial catch, and 1988-94 which was obtained by scientific sampling. No samples were collected after 1994 due to a lack of funds. Further, the 1977-94 data were obtained from within the White Sea proper, while Norwegian samples were obtained from outside the White Sea.

3.3.4 Population assessment

Data were presented on Russian pup surveys conducted during 1997-98 (Potelov *et al*., 1997; Chernook *et al*., this meeting, SEA-92; Potelov *et al*., this meeting, SEA-93; Potelov *et al*., this meeting, SEA-94). Estimates of 1997 pup numbers (Potelov *et al*., 1997) presented at the previous Working Group meeting were recalculated with isoline techniques (i.e., Krieging) using the computer program SURFER to generate zone contours (rather than the hand-drawn contours presented in Potelov et al. 1997). The revised, unadjusted pup estimate (171,378, 95% C.I. 167,628 to 175,128; Potelov *et al*. this meeting, SEA-94) was similar to the original estimate (161,442, 95% C.I. 150,425 to 172,459). The ensuing discussion focused on the amount of survey coverage available to support the analyses. A significant amount of photographic coverage occurred in 1997 beyond that reported in Potelov *et al* (1997), and that the Working Group felt this additional coverage may have been sufficient to support the analyses. An additional 31,319 pups were caught prior to the survey in 1997 (Golikov and Potelov, this meeting, SEA-95).

An experimental aerial pup survey conducted on 12 March 1998 further compared traditional transect and isoline estimates, as well as the effects of differing survey altitudes and weather conditions (Potelov *et al*., this meeting, SEA-93). Pup estimates from the visual and photographic (black and white imagery only) surveys were higher for the transect (9,679, 95% C.I. 5,882 to 13,476, and 12,300, 95% C.I. 8,558 to 16,042, respectively) than the isoline (8,831, 95% C.I. 6,820 to 10,842, and 8,777, 95% C.I. 7,757 to 9,797, respectively) method. The transect estimates had greater variance, although it is unclear whether the proper variance calculation was used for the isoline method. Both the transect and isoline techniques used the same visual and photographic data. However, the Working Group was troubled that while transect estimates produced higher estimates from the photographic survey than from visual survey, the isoline estimates from the two data sources were the same. Finally, photographs and discussion presented suggested that relatively low altitude surveys (e.g., 125 m) allowed the collection of reasonably useful imagery in marginal weather conditions (e.g., blowing snow).

The Working Group **commended** the Russian scientists for this research and encouraged them to continue experimentation with the isoline technique as an alternative to traditional transect analyses. The Group **recommended** that the sensitivity of the technique to the selection of strata bounds should be investigated to determine the robustness of the procedure. Simulation experiments were suggested as one approach to this evaluation. Variance calculations from the isoline method also require further attention.

Aerial surveys of White Sea harp seals were conducted on 7, 8, 12, and 16 March 1998 as a co-operative effort between Russian and Canadian scientists (Chernook *et al*., this meeting, SEA-92). Like a similar survey conducted during 1997 (Chernook *et al*., 1997a,b; Shafikov and Chernook, 1997), this survey was conducted by traditional strip transect methods using multiple sensors including black and white (B&W) and ultraviolet (UV) photography and thermal infra-red (IR) scanning; all devices were operated simultaneously during the survey. The IR imagery provided the largest strip widths with the UV providing the smallest. The B&W and IR imagery were used in a complimentary manner to improve estimates of pups. The UV imagery was used to obtain ratios of pups to adults. The 7 and 8 March surveys provided complete coverage of the area, while the 16 March survey, supplemented by the estimate from 8 March (areas not surveyed on 16 March), provided a second estimate. Results were not available from the 12 March survey.

Simultaneous ground counts were made of adults and pups in small areas on 8, 12, and 16 March for confirmation of the aerial (B&W and IR) estimates. These data were proposed as a correction to the survey estimates for pups that were not visible to the camera and for pups missed by the film readers. While the approach has considerable merit, the Working Group felt there was insufficient ground-truthing data (n=3 sample areas) to apply the factors, and recommended that the correction not be applied until alternative approaches can be explored. A second correction was proposed for unborn pups (the whelping ogive). These factors varied from 1.1 for the 7-8 March to 1.0 for the 16 March survey. Considerable discussion focused on the sources of data used for this analysis and the technique used for generating the factor. Ultimately, it was determined that these factors were reasonable and could be used to correct the 7, 8 March and 8, 16 March survey combinations.

Survey estimates were, therefore, calculated as the weighted average of 1) the 7 and 8 March surveys corrected for pups not born (factor = 1.1) and 2) the uncorrected 16 March survey plus the corrected 8 March survey. Added to each estimate was the number of pups harvested up to the survey date. The survey estimates were weighted by the inverse of their variances and resulted in an estimate of 301,000 (95% C.I. 243,000 to 359,000) pups. In accepting this estimate, the Working Group believes that it is likely to be conservative as no correction for reader error was applied. It was **recommended** that corrections for reader error, or bias, and for differences in counts produced by the UV and IR imagery be further investigated.

An additional pup estimate was potentially available from the survey using the data collected on adult numbers, and pup to adult ratios. The Working Group concluded that the pup survey itself was sufficient given that the surveys appeared to be of high quality, and because the correction of the adult counts introduced considerable variance into the estimate associated with variation in the pup to adult ratios. A single correction factor could not be used because of the considerable temporal variability in adult hauling behaviour. Thus, corrections would need to be applied on a frame by frame basis. The Working Group noted that the UV imagery could be used to estimate a correction factor for pups missed by the readers.

The Working Group concluded that the Russian - Canadian survey team should be **commended** for the high quality of the survey and the analyses. The Group **recommended** that the estimate of 301,000 pups be used as the preliminary estimate for White Sea and Barents Sea pup production for 1998. This estimate can be refined with the addition of estimates for the 12 March survey and data on the correction factors required for reader errors.

Using the model described in Skaug and Øien (this meeting, SEA-98; Ulltang 1989a; see below) and a pup production estimate of 301,000, the 1998 population of harp seals in the White Sea and Barents Sea stock was estimated (Table 4). Natural mortality (M1+) was varied between 0.09 and 0.11, a range similar to that seen in other harp seal stocks. Total population was also estimated under the assumption of $M_0 = 0.5$ and $M_{1+} = 0.1$ due to concerns about the possibility of increased mortality of pups in this stock (see below).

M_{1+}	M_0	Numbers ('000)		
		0	1+	Total
0.09	0.27	301	2,980	2,281
0.1	0.30	301	1,922	2,223
	0.50	301	1,736	2,037
0.11	0.33	301	1,873	2,174

Table 4. Estimated 1998 abundance of harp seals in the White Sea and Barents Sea based upon the 1998 pup production estimate of 301,000.

3.3.5 Catch options

Reproductive rate data from seals caught in the Barents Sea (Kjellqwist *et al.* 1995; Table 5) were incorporated into the Ulltang (1989a,b) model to examine possible harvest rates for this stock Skaug and Øien, this meeting, SEA-98). M_{1+} rates of 0.09, 0.1 and 0.11 were considered but the Working Group concluded that there were no data to indicate a difference in adult mortality rates between the three harp seal stocks. Therefore it was considered that an M_{1+} rate of 0.1 was the most appropriate, as it is the closest to that observed in other harp seal stocks where mortality has been estimated and results in a historical population that has been relatively constant since the 1950's. Given the lack of trends in this population this

value required the least assumptions regarding trends in this population. Pup mortality rates were assumed to equal three times adult mortality rates.

Mortality	$M_{1+} = 0.10$ $M_0 = 0.3$							
Proportion Mature	$p_4 = 0$	$p_5 = .1$	$p_6 = .18$	$p_7 = .35$	$p_8 = .6$	$p_9 = .7$	$p_{10} = .94$	$p_{11} = 1$
Pregnancy rate	$f = 0.84$							

Table 5. Biological parameters used to estimate population size and catch options for White Sea and Barents Sea harp seals. Pregnancy rates taken from Kjellqwist *et al.* (1995).

Age distribution data from Norwegian catches in the Barents Sea were used to estimate the age structure of the 1+ harvest. Norwegian data were used, as they comprised the majority of the 1+ catches (Appendix IV, Table 5). For the years from 1978 onwards, age distributions exist from every second year, and from 1989 onwards from every year. From the years without age samples the age distribution from the preceding year was used. From the year prior to 1978 the average of the age distribution from 1978 until recent was used.

From the years 1946–1970, the five-year average catches were used. From 1971–1998, annual catches were incorporated into the model. Recorded incidental catches of invasion harp seals for the years 1986–1988 and 1995 were added to the pup catches for the corresponding years.

Running the model with an adult mortality rate (M_{1+}) of 0.1, and pup mortality rates (M_0) of 0.3, 1999 catch options and catches in 2009 were estimated using the point estimate and the upper and lower 95% confidence limits (Table 6). For each estimate of pup production catch scenarios were provided for a harvest of 1+ only and for pups only.

Catch	Exploit. rate		1999 catch		1999 Pop. Size		2009 catch		2009 Pop. size	
Option	u_0	u_{1+}	Pups	1+	Pups	1+	Pups	1+	Pups	1+
$N_{1998,0} = 243{,}000$,										
1+	0	0.032	0	50100	241500	1565000	0	45000	224100	1404000
Pups	.385	0.000	96100	0	249500	1541000	101400	0	263200	1361000
$N_{1998,0} = 301{,}000$										
1+	0	.032	0	61100	299400	1906000	0	56000	281500	1747000
Pups	.385	0	119200	0	309300	1876000	127700	0	331300	1687000
$N_{1998,0} = 359{,}000$										
1+	0.000	0.032	0	72000	357300	2248000	0	66900	338800	2089000
Pups	0.385	0.000	142200	0	369100	2211000	153900	0	399400	2012000

Table 6. Catch options for harp seals in the White Sea and Barents Sea under different assumptions of starting pup production and age of catch. $M_{1+} = 0.1$ and $M_0 = 0.3$

Under the assumptions of this model the population size declines by approximately 10% by 2009. The 2009 catches are slightly lower than the 1998 catches if only 1+ seals are harvested while they are slightly greater if pups are taken.

Concerns were expressed by the Russian delegation, based on qualitative data, that pup mortality rates can vary substantially in the White Sea region, and that in recent years, these rates have been very high. Although additional pup mortality associated with by-catch in Norwegian fishing gear in 1986–89 and 1995 was added to the catches for these years, the impacts of increased pup mortality on the catch options was investigated by assuming that pup mortality equalled five times the 1+ mortality rate (Table 7). This scenario was examined only on the point estimate of 1998 pup production of 301,000.

Catch	Exploit. Rate		1999 catch		1999 Pop. Size		2009 catch		2009 Pop. size	
Option	u_0	u_{1+}	Pups	1+	Pups	1+	Pups	1+	Pups	1+
1+	0.000	0.018	0	31600	299400	1725000	0	29400	283200	1602000
Pups	0.249	0.000	76000	0	305000	1708000	77400	0	310700	1569000

Table 7. Catch options for harp seals in the White Sea and Barents Sea under different catch scenarios assuming 1998 pup production is 301,000 and mortality rates of $M_{1+} = 0.1$ and $M_O = 0.5$.

Assuming that pup mortality equalled five times the 1+ mortality, the estimates of 1999 harvests declined significantly. Catches of 1+ only decline from 61,000 to 31,600 while pup only catches are reduced from 119,000 to 76,000. Under this scenario the total population declines by approximately 8% by 2009.

The Working Group noted that this model solves for a constant exploitation rate and results in a slightly lower population. Models estimating a constant population would result in lower catch estimates. Given that historical estimates of abundance of this population are poorly documented, the 1998 pup production estimate is based on new methods for which no comparable data exists, and that no information on population trends is available, the Working Groups **recommends** that a conservative approach be adopted in establishing harvests. The recent anecdotal evidence for high pup mortality rates would also provide support for a conservative approach. The Working Group also **recommends** that other modelling approaches be explored.

3.4 The Northwest Atlantic Stock

3.4.1 Information on recent catches and regulatory measures

A Canadian quota of 275,000 animals was maintained for 1998. The large catches of harp seals observed during the 1996 and 1997 continued to increase in 1998 (Appendix IV, Table 10). The commercial harvest took 282,070 animals. Another 554 animals were taken for research purposes off the Newfoundland coast, for a total catch from the Northwest Atlantic of 282,624. The exact age composition of the catch is not yet available, but is believed to be primarily pups. Information on Canadian regulatory measures is presented in Appendix V, Table 3.

Some information is available on incidental harp seal catches from the US sink gill net fishery. The preliminary estimate for 1997 is 328 (95% C.I. 126-675) animals. It was suggested that these catches could be added to Northwest Atlantic harp catch data.

New data on harvests from Greenland since 1995 are not available. If current harvest levels are similar to 1995 then the harvest would be expected to be 60,000–65,000 animals.1

3.4.2 Current research

Biological sampling is continuing on the Newfoundland and Labrador coasts to obtain data on morphometrics, reproductive rates and diet composition. Satellite transmitters will be deployed on harp seals in the Gulf of St Lawrence during December 1998. An aerial survey to evaluate pup production in the Northwest Atlantic population is planned for March 1999.

3.4.3 Biological parameters

A summary of data on biological parameters for the Northwest Atlantic population were presented in Sjare *et al*. (this meeting, SEA-91).

1 Preliminary estimates of the Greenland catch were provided to the Working Group after the meeting. A total of 74,698 harp seals were reported caught in Greenland during 1996, an increase of 14,000 over 1995 (Appendix IV, Table 9a). Actual 1996 catches were likely higher since estimates were not corrected for unreported catches.

3.4.4 Information on the state of the stock

In light of the recent data from Greenland which indicate that Greenland harvests are much higher than previously thought, and the high harvest levels in the Canadian commercial hunt, it is possible that current harvests exceed replacement yield. The Working Group **recommends** that current replacement yields be estimated taking into account updated harvest data and pup production estimates.2

4 HOODED SEALS (*Cystophora cristata*)

4.1 Stock Identity, Distribution and Migrations

Two satellite transmitters were deployed on young hooded seals on the east coast of Greenland during July 1998 by Canadian and Greenland scientists. The Working Group noted that there was a report of whelping between Greenland and Iceland during the past 10 years. The possibility that this may be related to the poor ice conditions observed in the Greenland Sea whelping area over the same period should be investigated.

4.2 The Greenland Sea Stock

4.2.1 Information on recent catches and regulatory measures

Detailed information on Norwegian catches of hooded seals in the Greenland Sea in 1998 was not available to the Working Group, but was reported to be approximately 3,000 pups. The total quota was allowed to be taken as weaned pups with one adult equal to two pups. The catches were well below the allocated quota which has been reduced to 5,000 1+ animals (Appendix V, Table 1).

4.2.2 Current research

A sample of hooded seals (females, males and pups) were collected for toxicological an physiological studies. Sampling of ecological data from pups (see Haug *et al.*, 1996) and 1+ animals taken in commercial catches was planned on one of the vessels, but had to be cancelled due to technical problems on the allocated ship.

4.2.3 Biological parameters

Age distribution in Russian catches of breeding (1961–1992) and moulting (1990–1994) hooded seals was presented (Potelov, this meeting, SEA-96). The Working Group was also informed that relevant biological material had been collected by Russian scientists over the past years. Some of this material (e.g., reproductive parameters such as fertility rate and age at sexual maturity) has not been analysed, and Russian scientists were encouraged to complete the analyses of data from their scientific catches and present the results to the Working Group.

4.2.4 Population assessment

At the previous meeting of the Working Group (ICES CM 1998/Assess:3) the results of March 1997 surveys of hooded seal pup production in the Greenland Sea were presented (Øien, 1997b). An uncorrected estimate of pup production in six whelping patches (25,300, 95% C.I. 18,200–35,100) was obtained. However, the Working Group raised the possibility of an overlap among breeding patches and requested additional information. Unfortunately, this issue is still unresolved. To be conservative, the Working Group assumed that one of the surveyed patches was a mix of two others, and therefore, should be removed from the estimate. The resulting estimate of hooded seal pup production in the Greenland Sea in 1997 is 23,762 pups (95% C.I. 14,819–32,705). The Working Group acknowledged that this was a minimum estimate as it was not

2 The information on Greenland catches provided to the Working Group after the meeting indicate that total removals from the Northwest Atlantic population during 1996 were in the order of 317,000 (242,851 Canadian + 73,938 Greenland) which is greater than the replacement yield estimates provided by the Working Group (NAFO SCS Doc. 95/16 Serial No. N2569). Although recent catches in Greenland are not available, the increases in Canadian catches observed since 1996 suggest that total removals from this stock may have continued to exceed replacement yield.

corrected for the temporal distribution of births or pups born outside of the whelping patches. The Working Group noted that question of possible overlaps among patches may be resolved using available data on the proportion of solitary pups present during the surveys and encouraged Norwegian scientists to examine these data.

The 1998 population size of hooded seals in the Greenland Sea was estimated using the model described in Skaug and Øien (this meeting, SEA-98; Ulltang 1989a; see below) and a 1997 pup production estimate of 24,000 (Table 8). Natural mortality (M_{1+}) was varied between 0.09 and .11. M_0 was assumed to be $3M_{1+}$.

M_{1+}	Numbers		
	0	1+	Total
0.09	26,700	113,500	140,200
0.1	26,300	109,100	135,400
0.11	26,100	105,700	131,800

Table 8. Estimated 1998 abundance of hooded seals in the Greenland Sea under different assumption of 1+ mortality and a 1997 pup production estimate of 24,000. M_0 is assumed to be $3M_{1+}$.

4.2.5 Catch options

Reproductive rate data from the Northwest Atlantic stock (Born 1982; Table 9) were incorporated into the Ulltang (1989a,b) model to examine possible harvest rates for this stock (Skaug and Øien, this meeting, SEA-98). 1+ mortality was assumed to be 0.1 and $M_0 = 0.3$.

Mortality	M1+ = 0.10 M0 = 0.30							
Proportion Mature	p_2 = .18	p_3 = .44	p_4 = .60	p_5 = .75	P_6 = .87	p_7= .93	p_8 = .96	p_9 = 1
Pregnancy rate	f = 0.94							

Table 9. Biological parameters used to estimate population size and catch options for Greenland Sea hooded seals. Pregnancy rates taken from Born (1982).

Running the model with an adult mortality rate (M_{1+}) of 0.1, and pup mortality rates (M_0) of 0.3, catch options and stock size in 1999 and 2009 were estimated using the point estimate and the upper and lower 95% confidence limits of the 1997 pup production estimate (Table 10). For each estimate of pup production catch scenarios were provided for a harvest of 1+ only and for pups only.

Catch	Exploit. rate		1999 catch		1999 Pop. Size		2009 catch		2009 Pop. size	
Option	u_0	u_{1+}	Pups	1+	Pups	1+	Pups	1+	Pups	1+
$N_{1997,0}$ = 15,000										
1+	0.000	0.103	0	7300	15900	70200	0	6300	15200	61300
Pups	0.627	0.000	11100	0	17700	69300	12100	0	19300	60500
$N_{1997,0}$ = 24,000										
1+	0.000	0.103	0	11200	25700	108000	0	10200	24900	99200
Pups	0.627	0.000	18000	0	28600	106000	19800	0	31600	96400
$N_{1997,0}$ = 33,000										
1+	0.000	0.103	0	15200	35700	146800	0	14300	34800	138100
Pups	0.627	0.000	25000	0	39800	143700	27800	0	44300	133200

Table 10. Catch options for hooded seals in the Greenland Sea under different assumptions of starting pup production and age of catch. M_{1+} = 0.1 and $M_0 = 0.3$

4.3 The Northwest Atlantic Stock

4.3.1 Information on recent catches and regulatory measures

The 1998 Canadian quota was increased to 10,000 1+ animals (Appendix V, Table 3b). A preliminary estimate of the numbers of animals taken in the commercial harvest off Newfoundland is 10,148 (Appendix IV, Table 12). Current Greenland catches were not available.3

4.3.2 Current research

Biological samples to monitor morphometrics, reproductive rates and diet composition are being collected along the northeastern Newfoundland and Labrador coasts. In the Gulf of St Lawrence, monitoring of the condition of live animals on the whelping patch is continuing.

4.3.3 Biological parameters

A summary of the data on biological parameters for the Northwest Atlantic population were presented in Sjare *et al*. (this meeting, SEA-91).

4.3.4 Information on the state of the stock

No new information on the state of the stock was presented to the Working Group.

5 DRAFT ADVICE FOR ACFM

The ACFM advice from 1997 will be revised by the chairman and sent to the Working Group members by e-mail for comments prior to presentation in ACFM this year.

6 POPULATION MODELLING WORKSHOP

The Working Group restated that it is important to hold a workshop on population modelling methodology for harp and hooded seals. It will not be possible to hold this workshop in 1999, but **recommended** that it be held within the next two years. The Working Group agreed to consult via correspondence during the coming year in order to discuss objectives of this workshop and begin planning.

7 RECOMMENDATIONS FOR CHAIRMAN

The Working Group **recommends** that ACFM consider T. Haug (Norway) as a candidate for the new Chairman of this Working Group.

The Working Group also noted the efforts of the outgoing Chairman (G. Stenson, Canada) and thanked him for all of his work on behalf of the group.

8 FUTURE ACTIVITIES OF THE WORKING GROUP

The Group did not feel that a 1999 meeting would be necessary unless significant new data were available. The Group noted that the next meeting could occur in conjunction with a Population Modelling Workshop. Plans for the Workshop should proceed through Group communications via correspondence. Group members expect to reanalyse the Russian and Norwegian survey data and methods for the White Sea and Barents Sea harp seals and Greenland Sea hooded seals, respectively, in the coming year. Thus at the next meeting, major topics could include a review of the 1997–98 Russian and Norwegian surveys, in addition to a discussion of the results of the Canadian Northwest Atlantic harp seal pup surveys proposed for 1999.

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3 Preliminary estimates of the Greenland catch were provided to the Working Group after the meeting. Reported catches of hooded seals in Greenland increased from 7,330 in 1994 to 9,896 in 1996 (Appendix IV, Table 8). Harvest levels in 1995 were not yet available.

9 RECOMMENDATIONS

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

1) With respect to the White/Barents Sea:

   a) analysis of the 1998 photograph surveys be completed by i) providing an estimate for the 12 March survey, ii) estimating the bias due to reader's errors, and iii) clarifying the methods used to determine the temporal distribution of whelping;

   b) the robustness of the isoline method of estimating pup production be investigated, particularly with respect to the impact of the assumed density categories used;

   c) alternative models solving for constant population or constant catches be explored for catch options;

   d) tagging of harp seals in the White and Barents Seas should be resumed, 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 composition 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, and that sampling be continued;

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 availability and uncertainty;

8) Optimal survey frequency be evaluated and that research efforts during inter-survey years be designed to standardise survey techniques among areas and collect relevant biological data required for population assessments;

9) Replacement yields be estimated for the Northwest Atlantic harp seal stock incorporating updated harvest and pup production estimates.

10 OTHER BUSINESS

The Working Group was informed of recent correspondence with the ICES Secretariat and ACFM concerning the election of a new Chairman and the relationship between this and other Working Groups. The Chairman agreed to inform the Group if any further information becomes available.

11 ADOPTION OF THE REPORT

The meeting ended at 1700 on 2 October, 1998 However, efforts to modify the Ulltang (1998a,b) model for other stocks were expected to continue the next week. The Working Group decided that these efforts could be reviewed via e-mail and/or through a teleconference if they are available by 8 October. The final report was approved via e-mail October 15, 1998.

APPENDIX I

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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
   - 3.2.3 Population assessment
   - 3.2.4 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 Biological parameters
   - 3.4.4 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 Biological parameters
   - 4.3.4 Information on the state of the stock
5. Draft advice for ACFM
6. Population Modelling Workshop
7. Recommendations for Chairman
8. Future Activities of the Working Group
9. Recommendations
10. Other Business
11. Adoption of Report

APPENDIX III

REFERENCES

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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	-	-	-	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"), 1946–1998[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	.	.	.	.	.	.
1998	4	.	.	.	.	.	.

[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"), 1958–1998[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	-	-	-	-	-	-
1990-91	1	.	.	.	.	.
1992	2	.	.	.	.	.
1993	-	-	-	-	-	-
1993-94	1	.	.	.	.	.
1995–98[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"), 1946–1998[a,b].

	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[e]	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[f]	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
1998[g]	15	817	832	13350	20	13370	13365	837	14202

[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] Russian catches of 1+ animals after 1987 selected by scientific sampling protocols.

[f] Included 717 seals caught to the south of Spitsbergen, east of 14^{o} E, by one ship which mainly operated in the Greenland Sea.

[g] Preliminary numbers are given for the 1998 catch.

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

Year	Norwegian coast	Murman coast	Total
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	1379.		
1992	1583		
1993	2180		
1994	3238		
1995	10616		
1996	2838		
1997	3812		
1998	3575		

[1] Norwegian data are recorded catches, since 1981 recorded for compensation under regulations for damage to fishing gear. No compensation was paid in 1990, 1993, 1996 and 1998.

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, 1954–1996.

Year	West Greenland			East Greenland				Total
	N	NW-S	TOTAL	SE	KGH[c]	NE	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
1995								
1996[f]	16	6,180	6,196	3,638	-	62	3,700	9,896

[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.

[f] Preliminary figures provided to the Working Group after the meeting.

Table 9a. Catches of **harp seals** in Greenland, 1954–1987 (List-of-Game), and 1993–1996 (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
1996[c]	73,332	52	1,213	33	153	75	74,698

[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.

[c] Preliminary figures provided to the Working Group after the meeting.

Table 9b. Estimated catches of **harp seals** in Greenland, 1975–1987 and 1993–1995. Figures in bold are non-corrected figures from Table 9a.

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 off Newfoundland and in the Gulf of St. Lawrence, Canada ("Gulf" and "Front"), 1946–1998[a,b]. Catches from 1995 onward include catches under the personal use licences.

	Large Vessel Catch				Landsmen Catch				Total Catches			
ar	os		k	al	s		k	al	s		k	al
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 [e]	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 [e]	43767	23956	0	67723	43861	24748	0	68609
1993	8	111	0	119 [e]	16393	10491	0	26884	16401	10602	0	27003
1994	43	127	0	170 [e]	25180	36004	0	61184	25223	36131	0	61354
1995	4	218	0	222 [e]	34085	31306	0	65391	334089	31524	0	65613
1996	3	131	0	134 [e]	184853	57864	0	242717	184856	57995	0	242851
1997	0	6	0	6 [e]	220476	40560	0	261036	220476	43734	0	264211
1998[f]	7	547	0	554[e]	0	0	282070	282070	7	547	282070	282624

[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 in Newfoundland and may differ from NAFO values

[f] Preliminary estimates; age class breakdown for Landsmen catch not available yet.

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 off Newfoundland and in the Gulf of St. Lawrence, Canada ("Gulf" and "Front"), 1946–1998[a,b]. Catches from 1995 onward include catches under the personal use licences.

	Large Vessel Catches				Landsmaen Catches[c]				Total Catches			
Year	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	0	0	0	0	0	7058	0	7058	0	7058	0	7058
1998[f]	0	0	0	0	0	10148	0	10148	0	10148	0	10148

[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 in Newfoundland and may differ from NAFO values.

[e] Statistics no longer split by age

[f] Preliminary estimates

APPENDIX V. SUMMARIES OF SEALING REGULATIONS

Table 1. Summaries of Norwegian sealing regulations for the Greenland Sea ("West Ice"), 1985–1998.

	Opening	Closing	Quotas[1]				Allocations	
	Date	Date	Total	Pups	Fem.	Males	Norway	Soviet/Russia
Hooded Seals								
1985	22 March	5 May	(20,000)[2]	(20,000)[2]	0[3]	Unlim.	8,000[4]	3,300
1986	18 March	5 May	9,300	9,300	0[3]	Unlim.	6,000	3,300
1987	18 March	5 May	20,000	20,000	0[3]	Unlim.	16,700	3,300
1988	18 March	5 May	(20,000)[2]	(20,000)[2]	0[3]	Unlim.	16,700	5,000
1989	18 March	5 May	30,000		0[3]	Incl.	23,100	6,900
1990	26 March	30 June	27,500	0	0	Incl.	19,500	8,000
1991	26 March	30 June	9,000	0	0	Incl.	1,000	8,000
1992-94	26 March	30 June	9,000	0	0	Incl.	1,700	7,300
1995	26 March	10 July	9,000	0	0	Incl.	1,700[7]	7,300
1996	22 March	10 July	9,000[8]				1,700	7,300
1997	26 March	10 July	9,000[9]				6,200	2,800[11]
1998	22 March	10 July	5,000[10]				2,200	2,800[11]
Harp Seals								
1985	10 April	5 May	(25,000)[2]	(25,000)[2]	0[5]	0[5]	7,000	4,500
1986	22 March	5 May	11,500	11,500	0[5]	0[5]	7,000	4,500
1987	18 March	5 May	25,000	25,000	0[5]	0[5]	20,500	4,500
1988	10 April	5 May	28,000	0[5,6]	0[5,6]	0[5,6]	21,000	7,000
1989	18 March	5 May	16,000	-	0[5]	0[5]	12,000	9,000
1990	10 April	20 May	7,200	0	0[5]	0[5]	5,400	1,800
1991	10 April	31 May	7,200	0	0[5]	0[5]	5,400	1,800
1992-93	10 April	31 May	10,900	0	0[5]	0[5]	8,400	2,500
1994	10 April	31 May	13,100	0	0[5]	0[5]	10,600	2,500
1995	10 April	31 May	13,100	0	0[5]	0[5]	10,600[7]	2,500
1996	10 April	31 May[8]	13,100[9]				10,600	2,500[11]
1997-98	10 April	31 May	13,100[10]				10,600	2,500[11]

[1] Other regulations include: Prescriptions for date for departure Norwegian port; only one trip per season; licensing; killing methods; and inspection.

[2] Basis for allocation of USSR quota.

[3] Breeding females protected ; two pups deducted from quota for each female taken for safety reasons.

[4] Adult males only.

[5] 1 year+ seals protected until 9 April; pup quota may be filled by 1 year+ after 10 April.

[6] Any age or sex group.

[7] Included 750 weaned pups under permit for scientific purposes.

[8] Pups allowed to be taken from 26 March to 5 May.

[9] Half the quota could be taken as weaned pups, where two pups equalled one 1+ animal.

[10] The whole quota could be taken as weaned pups, where two pups equalled one 1+ animal.

[11] Russian allocation reverted to Norway.

Table 2. Summary of sealing regulations for the White and Barents Seas ("East Ice"), 1979–1998.[1]

Season	Opening dates		Closing date	Quotas – Allocations		
	Soviet/ Russian	Norwegian sealers		Total	Soviet/ Russia	Norway
Harp seals[2]						
1979–80	1 March	23 March	30 April[3]	50,000[4]	34,000	16,000
1981	-	-	-	60,000	42,500	17,500
1982	-	-	-	75,000	57,500	17,500
1983	-	-	-	82,000	64,000	18,000
1984	-	-	-	80,000	62,000	18,000
1985-86	-	-	-	80,000	61,000	19,000
1987	-	-	20 April[3]	80,000	61,000	19,000
1988	-	-	-	70,000	53,400	16,600
1989–94	-	-	-	40,000	30,500	9,500
1995	-	-	-	40,000	31,250	8,750[5]
1996	-	-	-	40,000	30,500	9,500
1997-98	-	-	-	40,000	35,000	5,000

[1] Quotas and other regulations prior to 1979 are reviewed by Benjaminsen, 1979.
[2] Hooded, bearded and ringed seals protected from catches by ships.
[3] The closing date may be postponed until 10 May if necessitated by weather or ice conditions.
[4] Breeding females protected (all years).
[5] Included 750 weaned pups under permit for scientific purposes.

Table 3a. Major management measures implemented for harp seals in Canadian waters, 1960–1998.

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 sale of whitecoats 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 (1960–1998).

Year	Management Measure
1964	Hunting of hooded seals banned in the Gulf area (below 50^{o}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 sale of bluebacks prohibited under the Regulations.
1995	Personal sealing licences allowed (adult pelage only).
1998	TAC increased to 10,000