Appendix 8

THE 32ND SESSION OF THE JOINT NORWEGIAN - RUSSIAN FISHERIES COMMISSION, ST. PETERSBURG, RUSSIA 10 - 14 NOVEMBER 2003

REPORT OF THE WORKING GROUP ON SEALS

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1. EXCHANGE OF INFORMATION AND SUMMARY OF SEAL CATCHES IN 2003

Norwegian catches were taken by three vessels in the Greenland Sea and one vessel in the southeastern Barents Sea. For logistical reasons, Russian seal vessels did not carry out hunting in the Greenland Sea in 2003. Russian catches of harp seals in the White Sea were taken by local hunters using helicopters.

The recommended 2003 TACs for Greenland Sea hooded seals was 10,300 one year old and older (1yr+) animals or an equivalent number of pups - if a harvest scenario including both 1yr+ animals and pups were chosen, one 1yr+ animal should be balanced by 1.5 pups. For the Greenland Sea harp seals, the 2003 TAC was recommended at 15,000 1yr+ animals or an equivalent number of pups (where one 1yr+ animal should be balanced by 2 pups). The 2003 TAC recommended for harp seals in the Barents Sea and White Sea was defined at 53,000 1yr+ animals or an equivalent number of pups where one 1yr+ animal should be balanced by 2.5 pups. Norway was allocated a quota of 10,000 1yr+ animals (with a similar equivalence between 1yr+ animals and pups). All 2003 seal quotas followed the recommendations given by the ICES Advisory Committee on Fisheries Management (ACFM).

Norwegian and Russian catches in 2003, including catches under permits for scientific purposes, are summarized in the table below:

Area/species	Norway	Russia	Sum
GREENLAND SEA			
Harp seals			
Pups	161	0	161
Older seals (1yr+)	2116	0	2116
Sum	2277	0	2277
Hooded seals			
Pups	5206	0	5206
Older seals (1yr+)	89[1]	0	89
Sum	5295	0	5295
Area subtotal	7572	0	7572
BARENTS SEA / WHITE SEA			
Harp seals			
Pups	2343	37936	40279
Older seals (1yr+)	2955	0	2955
Sum	5298	37936	43234
Area subtotal	5298	37936	43234
TOTAL CATCHES	12870	37936	50806

[1] Including 12 1yr+ animals taken under permit for scientific purposes

2. EXCHANGE OF INFORMATION AND SUMMARY REPORTS OF RESEARCH ACTIVITIES IN 2003

2.1 Norwegian research

2.1.1 Estimation of pup production – Greenland Sea harp seals

From 14 March to 6 April 2002 aerial surveys were carried out in the Greenland Sea pack-ice (the West Ice), to asssess the pup production of the Greenland Sea population of harp seals. One fixed-wing twin-engined aircraft (stationed in Scoresbysound, Greenland, but also permitted to use the Jan Mayen island as a base) was used for reconaissance flights and photographic surveys along transects over the whelping patches once they had been located and identified. A helicopter, stationed on and operated from the applied research vessel (R/V"Lance"), assisted in the reconnaissance flights, and subsequently flew visual transect surveys over the whelping patches. The helicopter was also used for age-stageing of the pups, performed along transects over the patches. Three harp seal breeding patches (A, B and C) were located and surveyed either visually and/or photographically. The total estimate of pup production, including visual survey of Patch A, both visual and photographic surveys of Patch B, and photographic survey of Patch C, was 98 099 (SE=20 419.1), giving a coefficient of variation for the survey of 20.4%.

It is recommended that comprehensive aerial surveys needed to provide estimates of current pup production should be conducted periodically (every 5 year), and that efforts should be made to ensure comparability of survey results. Therefore, the 2002 field work in the Greenland Sea included participation by a Canadian scientist with substantial experience from similar surveys in the Northwest Atlantic. Also, the subsequent analyses of images from the photographic surveys included participation of Canadian and Russian scientific personell with experiene from similar analyses from harp seal surveys in the northwest Atlantic and White Sea, repectively.

Available knowledge of previous abundance of Greenland Sea harp seals is rather restricted. During the period 1977-1991, about 17 000 harp seal pups were tagged in a comprehensive mark-recapture experiment in the Greenland Sea. Based on this experiment, pup production was estimated to be 67 300 (95% CI 56 400-78 113) in 1991. Incomplete aerial surveys performed in 1991 suggested a minimum pup production in this year in excess of 55 000. The present estimate, obtained 11 years later, is certainly higher than the 1991 estimates. It is also higher than the projected 2000 estimate (76 700; 95% CI 48 000 – 105 000), which was obtained using a new population model which was based on original reproductive parameters and tuned to available pup production estimates. It is important to note, however, that estimates made by different methods are not necessarily comparable, and direct comparisons of the presented 2002 aerial survey results with previous results to quantify changes in pup production should in principle not be done.

2.1.2 Ecological role – Greenland Sea harp and hooded seals

To enable an assessment of the ecological role of harp and hooded seals throughout their

distributional range of the Nordic Seas (Iceland, Norwegian, Greenland Seas), a project was initiated in 1999 by members of the NAMMCO Scientific Comittee. The project pays special attention to the period July-February (i.e., between moulting and breeding), which is known to be the most intensive feeding period for both harp and hooded seals. To provide data, seals were collected for scientific purposes on expeditions with R/V"Jan Mayen", conducted in the pack ice belt east of Greenland in September/October 1999 and 2002 (autumn), July/August in 2000 (summer), and February/March in 2001 (winter). Results from analyses of stomach and intestinal contents from captured seals revealed that the diet of both species in this particular habitat were comprised of relatively few prey taxa. Pelagic amphipods of the genus *Parathemisto* (most probably almost exclusively *P. libellula*), the squid *Gonatus fabricii,* the polar cod *Boreogadus saida,* the capelin *Mallotus villosus*, and sand eels *Ammodytes* spp were particularly important. Although their relative contribution to the diet varied both with species and sampling period/area, these five prey items constituted 63-99% of the observed diet biomass in both seal species, irrespective of sampling period.

For the hooded seals, *G. fabricii* was the most important food item in autumn and winter, whereas the observed summer diet was dominated by polar cod, however with important contribution also from *G. fabricii* and sand eels. The latter was observed on the hooded seal menu only during the summer period, while polar cod, which contributed importantly also during the autumn survey, was almost absent from the winter samples. During the latter survey, also capelin contributed to the hooded seal diet. *Parathemisto* was most important for the harp seals during summer and autumn, whereas in winter the contribution from krill, capelin, and some other fish species were comparable and even larger. Harp seals appeared to consume some *G. fabricii* at all sampling periods, whereas polar cod, taken mainly in summer and autumn, was replaced by capelin and other fish species on their menu in winter.

The obtained results suggest that the ecology and distribution of the observed prey species can be related to known predator distribution and diving behaviour to give an account of how these seals fit into the Greenland Sea ecosystem. Obviously, the relative contribution of the most important prey species to the diet varied between the two seal species. Hooded seal diets appeared to be particularly characterized by squid *G. fabricii* and polar cod, but pelagic crustaceans (amphipods and krill) were important for harp seals. When the relative intestinal prey composition were compared quantitatively among co-occurring harp and hooded seals in the winter 2001 sample, differences were observed. These are probably the result of different foraging depths of the two seal species. Studies of diving behaviour of harp and hooded seals in the Greenland Sea have revealed that both species usually perform more shallow dives during summer than during winter, and that hooded seals dive to deeper waters than harp seals in both periods. Except for the youngest stages, which may occur in the upper water layers during summer, the major hooded seal prey *G. fabricii* has a typical mesopelagic distribution with occurrence mainly at depths greater than 400 m. This is in contrast to the distribution of the major food of harp seals: the observed krill and amphipod species are usually confined to the more upper water layers (< 200m depth). The methods used in diet studies assumes that whole prey species are taken. If parts of fish (e.g., the belly or other parts not including head with otoliths) are eaten this might well occur unregistrated in the performed analyses.

2.1.3 Sampling from harp seals taken as by-catch in gill nets

Biological data from 30 harp seals, taken as bycatch in March-April in gill-net fisheries in Finnmark, North Norway, were collected in 2003. Sampling included sex, age, condition and stomach contents, and the material is being analysed.

2.2 Russian research

2.2.1 Estimation of pup production of harp seals in the White Sea

During the 1997 and 1998 meetings of the Joint ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP), it was noticed and appreciated that Russian scientists had made substantial efforts to obtain reliable pup production estimates for the White and Barents Sea stock of harp seals. In March 2000, Russian scientists conducted two fully independent surveys of the pups on breeding lairs in the White Sea: one with helicopter and one with airplane. The results from these surveys were presented to the 2000 (Copenhagen) meeting of WGHARP and the helicopter survey results have been published in the international scientific journal in 2003. Using the strip transect method, a mean uncorrected estimate of pups of 325,643 (SE=36,168), including pups harvested prior to the survey (30,729 pups), was obtained in the helicopter surveys. In the aeroplane survey, an uncorrected pup production estimate of 339,710 (SE=32,400), which includes pups harvested prior to the survey (30,729 pups), was obtained.

At the most recent WGHARP meeting (Arkhangelsk, Russia, 2003) Russian scientists presented data from harp seal pup surveys conducted in the White Sea in 2002 and 2003. The aerial surveys with photographing on transects on the whelping grounds, the "Arctica" AN-26 plane, equipped with video and the photo facilities (including a camera capable to take pictures of seals in the IR-range) was used. Numbers of harp seal pups in 2002 were estimated at 330,000 (according to a 20 March survey) and in 2003 328,000 (according to surveys performed on 18 and 21 March). The new Russian results were accepted and approved by WGHARP at the September 2003 session. The present Working Group **commend** the high quality of the Russian research in both aeroplane and (previous) helicopter surveys.

2.2.2 Harp seal breeding in the White Sea in 2003

Studies of the White Sea harp seal breeding period were conducted from February 28 to March 9 in 2003. In total, 1957 pups were checked for sexual ratio (the males were on excess, the sexual ratio was to 1:1.1).

On February 28 about 50 % of pups were 1-2 days old (n=285). By March 2 the fraction of this age group was reduced to 20 % (n=282), up to March 4 this parameter was on level of 24 % (n=166). On the last day of harvest (March 8) the share of newborns was about 8 %.

Average pup body weight on February 28 was 12,5±0,12 kg (n=285). On March 2 the body weight had increased to 15,3±0,21 kg (n=282) , on March 4 it was 16,4±0,37 kg (n=166), and on March 9 it was 18,9±0,30 kg (n=166). The 1995-2003 studies of harp seal whelping terms have

shown that the 2003 data corresponds well to the average long-term parameters. The average weight of harp seal pups caught on ice during the period from March 22 to March 29, were 37,4±0,66 kg (n=79) for ragged jacket pups and 37,6±1,68 kg (n=11) for beaters, which corresponds to the average long-term data.

From the recent aerial surveys, executed in late February - early March, it has been found out that whelping patches in the White Sea are formed in the depth of ice fields within the center of the Basin area, much more southward than in the last 6 years. In the western and northern parts of the Basin the absence of ice suitable for harp seal whelping was observed. This situation, in combination with strong winds of western directions, caused a fast outward drift of the whelping patches from the Basin to the northern White Sea parts (Gorlo and Voronka areas).

To study harp seal distribution within the Mezen Gulf (in the White Sea) an expedition was organized in May 2003. No invasion to and mass mortality along the coasts in the Mezen Gulf were observed. Similar inspections were carried out within the Kandalaksha Bay in May 2003, but without observattions of mass mortalities (as were observed in 1998 and 2001). Collection of information from local fishermen during the spring-and-summer period did not indicate mass mortality either during the 2003 season. It is expected that the pup mortality rate in the White Sea in 2003 was close to the average long-term values.

2.3. Joint Norwegian-Russian work

2.3.1 Studies of reproduction

Trends in mean age at sexual maturity (MAM) were analysed for the Greenland Sea and Barents/White Sea stocks of harp seals based on data series collected by Russian and Norwegian scientists from the early 1960s to the early 1990s. Together with historical data on length at age, values of MAM are used as indicators of per capita resource levels in the two stocks of Northeast Atlantic harp seals. There was no long term trends in the Greenland Sea data set: A common MAM of 5.6 years could be fitted to data from 1959-90 and there were no significant differences in length at age of moulting females between samples collected in 1964 and 1987. For Barents Sea/White Sea harp seals, MAM increased significantly from 5.4 years in the period 1962-72 to 8.2 years in the period 1988-1993 concurrently with a decline in body growth rates found in earlier studies. The results indicate stock specific differences in per capita resource levels for maturing females, which might be related to different trends in stock abundance or density independent changes in habitat quality for the two stocks. The high values of MAM and low growth rates in the Barents Sea stock in the late 1980s to early 1990s coincided with severe depletion of important prey species in the Barents Sea, reports of mass invasions of harp seals alongthe Norwegian coast and indications of reduced body condition. All of this is consistent with a hypothesis of reduced per-capita resource levels within the distribution area of Barents Sea harp seals at that time, but no cause-and-effect relationship for the long-term trend in age at maturity can be established.

2.3.2 Abundance estimation

On several occasions WGHARP has discussed the possibilities and undisputable advantages involved in exchange of scientists between the ”harp-and-hooded-seal-counting” countries during each others field work and subsequent analyses, discussions and presentations of results. This would ensure standardisation of both the field- and analytical methods involved. For this reason Norwegian scientists patrticipated in the 2000 aerial surveys in the White Sea, and have also taken part in the subsequent analyses and presentations of the data. Furthermore, one Russian expert has participated in the analyses of material collected during the Norwegian 2002 aerial surveys in the Greenland Sea.

2.3.4 Harp seal / capelin overlap

In September 2001 and 2002, Norwegian and Russian scientists performed aerial surveys, using an especially designed Russian aeroplane, in the northeastern Barents Sea. The main aim of these surveys were to assess whether there was an overlap in distribution, and thus potential predation, between harp seals and capelin at this time of the year. The personell in the plane cooperated with Norwegian and Russian research vessels which assessed the distribution and abundance of capelin in the area simultaneous with the aerial surveys. The observations made indicated that harp seals were primarily found in drift ice areas, north of the key areas for capelin, thus indicating only low degree of distributional overlap between the two species in September.

2.3.5 Joint seal age estimations

In spring 2003 a joint Norwegian-Russian age-reading experiment on harp seal teeth was conducted in Tromsø with participation of one age reader from Russia (SevPINRO) and 2 age readers from Norway (IMR). Age estimates of known age teeth suggested a general tendency to overestimate age by 1 year or more in the age classes 5-11 years while the age of older animals tended to be overestimated. Graphical inspections of the results suggested differences between readers in both accuracy and precision, but these were not found to be statistically significant. Overall the study indicates that age estimates of harp seals should be treated as probability distributions rather than point estimates even in the youngest age classes. Adequate description of the probability distributions and the effects of having different readers can only be achieved by repeating the experiment with a much larger sample size.

3. STATUS OF STOCKS AND MANAGEMENT ADVICE FOR 2004

WGHARP met at SevPINRO, Arkhangelsk, Russia, 2-6 September 2003 to assess the stocks of Greenland Sea harp seals, White Sea / Barents Sea harp seals and Greenland Sea hooded seals. New information about pup production was available, and enabled WGHARP to perfrom modelling which provided ICES with sufficient information (at the ACFM meeting in Copenhagen, Denmark, 8-17 October 2003) to give advice on status and to identify catch options that would sustain the populations at present levels withnin a 10 year period.

Management agencies have requested advice on “sustainable” yields for these stocks. ICES notes

that the use of "sustainable" in this context is not identical to its interpretation of "sustainable" applied in advice on fish and invertebrate stocks. "Sustainable catch" as used in the yield estimates for seals means the catch that is risk neutral with regard to maintaining the population at its current size within the next 10 year period.

Population assessments were based on a new population model that estimates the current total population size using the historical catch data and estimates of pup production. These estimates are then projected into the future to provide a future population size for which statistical uncertainty is provided for each set of catch options.

There are several significant differences between the current model and the one used for the previous assessment (in 2000). The previous model used only two age classes (pups and 1+ animals), while the new model uses 20 age classes. Information about age composition in catches is available from age estimations from annual rings in canine teeth. Work carried out following the previous assessment, including discussions on and recommendations from the Workshop to Develop Improved Methods for Providing Harp and Hooded Seal Harvest Advice, indicated that the earlier model was less appropriate than a model with a full age structure. The same population dynamic model was used for all three of the northeast Atlantic populations, but with stock specific values of biological parameters. The inclusion of a full age structure into the model was an improvement from previously used estimation programs. In general the new model gives lower catch options than previous models. This is due to uncertainty in, in some cases also complete lack of, updated relevant data for the assessed stocks.

The advice given by ICES in 2003 was used by this Working Group on Seals to establish management advice for 2004 to the Joint Norwegian-Russian Fisheries Commission.

3.1. Greenland Sea

The Working Group **recommends** the following opening dates for the 2004 catch season: 1) Sucling pups, opening date of 18 March (0700 GMT) for catches of pups of both harp and hooded seals; 2) weaned pups, opening dates 20 March for hooded seals and 1 April for harp seals; 3) seals aged 1 yr and older (1yr+), opening date 22 March for hooded seals and between 1 and 10 April for harp seals. Adult hooded seal males should be permitted taken from 18 March. The Group recommends a closing date set at 30 June (2400 GMT) for harp seals and 10 July (2400 GMT) for hooded seals in 2004. Exceptions on opening and closing terms may be made in case of unfavourable weather or ice conditions. If, for any reason, catches of pups are not permitted, quotas can be filled by hunting moulting seals.

The Working Group agreed that the ban on killing adult females in the breeding lairs should be maintained for both harp and hooded seals in 2004.

3.1.1 Hooded seals

The Working Group noted the conclusion from ACFM that recent removals have been below the recommended sustainable yields.

The pup production and total population for 2003 was obtained using the model described above. Inputs to the model were:

Pup production estimate: Aerial surveys in 1997 resulted in estimates of pup production in the Greenland Sea of 23 762 pups (95% C.I. 14 819 to 32 705). This estimate is considered to be negatively biased since it was not corrected for the temporal distribution of births or for scattered pups. The actual number of pups produced in 1997 could, therefore, be larger.
Natural mortality: $M_{1+} = 0.12$.
Pup mortality: $M_0 = 3M_{1+}$.
Age at maturity ogive:
Estimated proportion of mature females (p) at ages 2-10, based upon data obtained from the NW Atlantic population

Age	2	3	4	5	6	7	8	9	10
P	0.029	0.262	0.504	0.734	0.802	0.802	0.850	0.908	1.00

Pregnancy rate for mature females: F=0.97

Based on this input, the model estimated the following 2003 abundance for Greenland Sea hooded seals: 120 000 (95% C.I. 65 000-175 000) 1+ animals with a pup production of 29 000 (95% C.I. 17 000-41 000).

The 1997 estimate of pup production is the only estimate available for the Greenland Sea hooded seal stock. The single estimate of pup production is over 6 years old and there are no estimates of reproductive rates for this stock. Therefore, any advice provided should be extremely cautious. One method of providing advice in such data poor situations is through the use of the Potential Biological Removals (PBR) approach. The Potential Biological Removal (PBR) has been defined as:

$$PBR=0.5 \cdot R_{Max} \cdot F_r \cdot N_{Min},$$

where R_{Max} is the maximum rate of increase for the population , F_r is a recovery factor with values between 0.1 and 1 and N_{Min} is the estimated population size using 20th percentile of the log-normal distribution. R_{Max} is set at a default of 0.12 for pinnipeds. It is appropriate to set the recovery factor (F_r) 0.75 given the time since the last survey and uncertainty in parameters used to determine the total abundance.

The PBR approach can be used when only a single estimate of abundance is available. This approach would be appropriate within the precautionary approach to marine resource management implemented by ICES.

Based on a request from the Joint Norwegian-Russian Fisheries Commission, ICES was requested to give options (with indication of medium term consequences) for three different catch scenarios:

- Current catch level (average of the catches in the period 1999 – 2003)
- Sustainable catches.
- Two times the sustainable catches.

For the reasons outlined above, however, ICES rather recommend a PBR-based approach. A catch of 5 600 hooded seals in 2004 would sustain the population at present level. The Working Group **recommend** that this be used as a basis for the determination of a TAC for hooded seals in the Greenland Sea in 2004:
5,600 animals (irrespective of age).

3.1.2 Harp seals

The Working Group noted the conclusion by ICES that recent removals have been below the recommended sustainable yields, and that prolongation of current catch level will likely result in an increase in population size.

The model solves for a constant exploitation which stabilise the 1+ population. Inputs to the model were:

Pup production estimates (from previous tag-recapture experiments (1983-1991) and from recent (2002) aerial surveys):

Year	Pup production estimates	c.v.
1983	58539	.104
1984	103250	.147
1985	111084	.199
1987	49970	.076
1988	58697	.184
1989	110614	.077
1990	55625	.077
1991	67271	.082
2002	98099	.204

Natural mortality: $M_{1+} = 0.12$.
Pup mortality: $M_0 = 3M_{1+}$.
Age at maturity ogive: p(3) = 0.058, p(4) = 0.292 p(5) = 0.554, p(6)=0.744, p(7)=0.861, p(8)=0.926, p(9)= 0.961, p(10)=0.980, p(11)=0.990, p(12)=0.995, p(13)=0.997, p(14)=0.999, p(15)=0.999
Pregnancy rate for mature females: F=0.833.

Based on this input, the model estimated the following 2003 abundance for Greenland Sea harp seals: 349 000 (95% C.I. 319 000-379 000) 1+ animals with a pup production of 68 000 (95% C.I. 62 000-74 000).

Based on a request from the Joint Norwegian-Russian Fisheries Commission, ICES gave **catch options** for three different catch scenarios:

- Current catch level (average of the catches in the period 1999 – 2003)
- Sustainable catches.
- Two times the sustainable catches.

The sustainable catches are defined as the (fixed) annual catches that stabilise the future 1+ population. The catch options are further expanded using different proportions of pups and 1+ animals in the catches.

As a measure of the future development of the estimated population, the ratio between the size of the 1+ population in 2013 and 2003 is used.

					10 Year Projection
Option #	Catch level	Proportion of 1+ in catches	Pup catch	1+ catch	$N_{2013,1+} / N_{2003,1+}$
1	Current	48% (current level)	1953	1819	1.16
2	Sustainable	48%	5990	5530	1.01
3	Sustainable	100%	0	8200	1.02
4	2 X sust.	48%	11981	11059	0.79
5	2 X sust.	100%	0	16400	0.81

While current catch level (option 1) will likely result in an increase in population size, ICES emphasized that a catch of 8,200 1+ animals (catch option 3), or an equivalent number of pups, in 2004 would sustaina the population at present level within a 10 year period. The Working Group **recommend** that this be used as a basis for the determination of a TAC for harp seals in the Greenland Sea in 2004:
8,200 1+ animals or an equivalent number of pups. If a harvest scenario including both 1+ animals and pups is chosen, one 1+ seal should be balanced by 2 pups.
Catches 2X sustainable levels will result in the population declining by approximately 20-25% in the next 10 years.

3.2 The Barents Sea / White Sea

The Working Group **recommends** the following terms concerning opening and closing dates and areas of the catches: From 27 February to 20 April for Russian coastal catches and from 23 March to 20 April for Norwegian and Russian sealing ships. However, it is proposed that, in the case of difficult weather or ice conditions, the harvesting can be prolonged till 10 May. Exceptions from opening and closing dates should be made, if necessary, for scientific purposes. The Norwegian participants in the Working Group suggest to prolong dates of harvesting to 1 July, and to determine the operational areas for the Norwegian catch activities to be the southeastern Barents Sea to the east of 20°E.

The Working Group agreed that the ban on killing adult harp seal females in the breeding lairs should be maintained in 2004.

3.2.1. Harp seal.

The Working Group noted the conclusion by ICES that recent removals have been below the recommended sustainable yields, that prolongation of current catch level will likely result in an increase in population size, and that there is some evidence that densities may be so high that biological processes like rate of maturation may be showing density dependent effects.

The model solves for a constant exploitation which stabilise the 1+ population. Inputs to the model were:

Pup production estimates (from Russian aerial surveys):

Year	Pup production estimate	c.v.
1998	286 260	.073
2000	322 474	.089
2000	339 710	.095
2002	330 000	.200

Natural mortality: $M_{1+} = 0.09$.
Pup mortality: $M_0 = 5M_{1+}$ (fixed)
Age at maturity ogive: p(5) = 0.1, p(6) = 0.18, p(7) = 0.35, p(8)=0.6, p(9)=0.7, p(10)=0.94, p(11)= 1.0
Pregnancy rate: F=0.84.

The first (1998) pup production estimate is uncorrected, while the later ones have corrections applied. For 2000 there are two independent estimates for pup production.

Based on these input values, the model estimated the following 2003 abundance of harp seals in the White Sea: 1 829 000 (95% C.I. 1 651 000-2 006 000) 1+ animals with a pup production of 330 000 (95% C.I. 299 000-360 000).

Based on a request from the Joint Norwegian-Russian Fisheries Commission, ICES gave **catch options** for three different catch scenarios:

- Current catch level (average of the catches in the period 1999 – 2003)
- Sustainable catches.
- Two times the sustainable catches.

The sustainable catches are defined as the (fixed) annual catches that stabilise the future 1+ population. The catch options are further expanded using different proportions of pups and 1+

animals in the catches.

As a measure of the future development of the estimated population, the ratio between the size of the 1+ population in 2013 and 2003 is used.

					10 Year Projection
Option #	Catch level	Proportion of 1+ in catches	Pup catch	1+ catch	$N_{2013,1+} / N_{2003,1+}$
1	Current	7% (current level)	37979	2992	1.16
2	Sustainable	7%	102 486	7 714	0.99
3	Sustainable	100%	0	45 100	1.03
4	2 X sust.	7%	204 972	15 428	0.71
5	2 X sust.	100%	0	90 200	0.80

While current catch level (option 1) will likely result in an increase in population size, ICES emphasized that a catch of 45,100 1+ animals (catch option 3), or an equivalent number of pups, in 2004 would sustain the population at the present level within a 10 year period. The Working Group **recommend** that this be used as a basis for the determination of a TAC for harp seals in the Greenland Sea in 2004:
45,100 1+ animals or an equivalent number of pups. If a harvest scenario including both 1+ animals and pups is chosen, one 1+ seal should be balanced by 2.5 pups.
Catches 2X sustainable levels (options 4 and 5) will result in the population declining by approximately 20-25% in the next 10 years.

3.2.2 Other species

The Working Group agreed that commercial hunt of bearded seals should be banned in 2004, as in previous years, but it **recommend** to start catch under permit for scientific purposes to investigate results of long time protection.

3.3 Biological limits of yield

Biological limits of yield reflecting very low risk of collapse must be developed within a Precautionary Approach framework. ICES discussed a recent approach on the application of the Precautionary Approach (PA) and conservation reference points to the management of harp and hooded seals, originally developed for the stocks in the Northwest Atlantic. Within this framework, conservation, precautionary and target reference points can be identified and linked to specific actions to aid in managing the resource. For seals, abundance and yield should be identified in terms of numbers rather than as biomass (as done in fish).

Harp and hooded seals are commercially exploited to varying levels throughout the North Atlantic. The availability of scientific information concerning the status of these resources (abundance, reproductive and mortality rates) also varies between the species. A conceptual

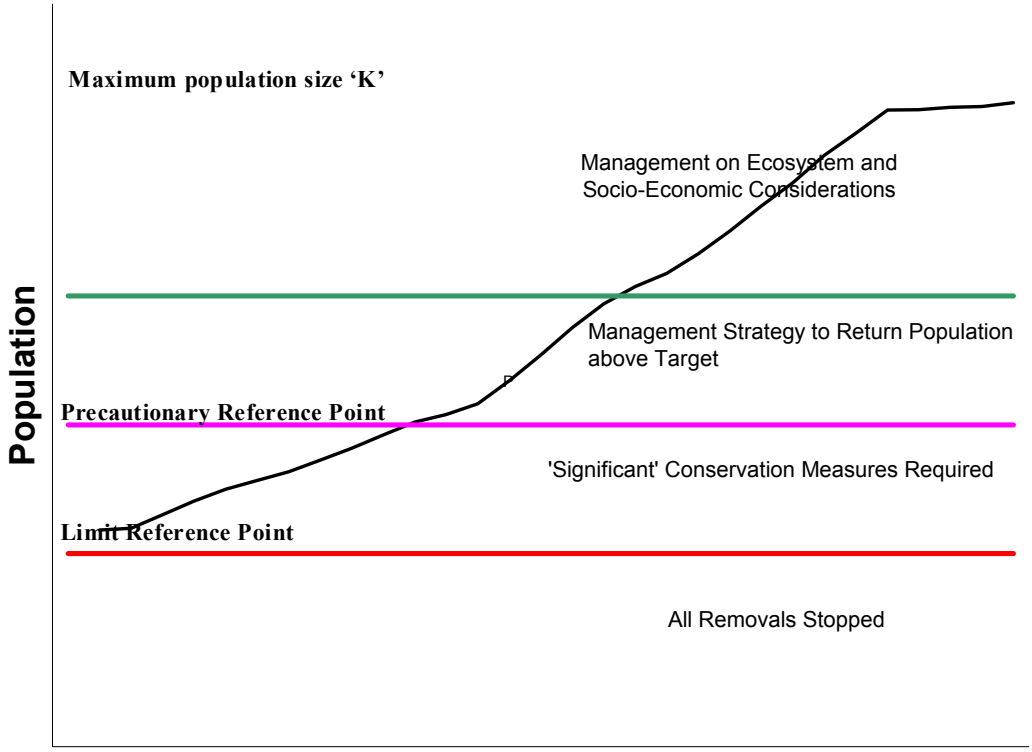
framework for applying the PA to Atlantic seal management was outlined (see figure below). For a data rich species, one target, one precautionary and one conservation reference level are proposed. A target reference level could be established at 70% (N_{70}) of the pristine population size or a proxy of the pristine population (e.g. maximum population size). When populations fall below N_{70}, conservation objectives assume a greater role in the setting of harvest levels, and measures are put in place to allow the population to increase above the precautionary reference level. A precautionary level is established at 50% of the estimated pristine population size, while a conservation limit (or limit reference point) resulting in closure of commercial harvesting is established at 30% of the estimated maximum population size. It should be stressed that the percentages given above are just meant as an example, in this case taken from a framework suggested for the Northwest Atlantic population of harp seals. The suggested percentages resulted from a review of general models used in fisheries literature and of an approach developed in the conservation literature.

In the northwest Atlantic, it is required that populations have at least three abundance estimates, that the most recent abundance estimate is no more than 5 years old, and that recent data on fecundity or mortality rates are available – otherwise the population would be considered data poor, and requires a more risk adverse approach to their management. In data poor situations, the uncertainty associated with the resource's status and the impact of a particular management action increases and as a result, more caution is required. This could be accomplished by identifying the maximum allowable removals that will ensure that the acceptable risk of the population falling below this reference point is only 5%. This level has been referred to as the Potential Biological Removal (PBR) and can be approximated using default values and an estimate of abundance. Since the only data required is an estimate of population size, this or a similar approach is appropriate for data poor species. The PBR approach has the added advantage that the simulation trials used to establish the appropriate population size (N_{Min}) ensured that the formulation is robust when the model assumptions are relaxed and plausible uncertainties are included.

ICES notices the similarity between the suggested framework for seals and the framework used in the management of fish resources. ICES will further develop the seal framework and will propose reference points, if possible, for the different harp and hooded seal populations.

As yet, no reference points are proposed for the individual stocks of harp and hooded seals in the Northeast Atlantic. Until such reference points are established ICES suggests that harvesting could be continued at recent levels or at levels that will sustain the stocks at present level with high probability.

Figure below: Suggested reference points and control rules for implementing the Precautionary Approach into the management of harp and hooded seals in the North Atlantic. The curve indicates the growth of the northwest Atlantic harp seal population from the late 1970s and up to date.



3.4 Prospects for future sealing activities

3.4.1 A joint Norwegian-Russian workshop - background

There are concerns over the current lack of ability on both the Norwegian and Russian side to fulfill given quotas on harp and hooded seals. Also, the multispecies perspective of seal management is a matter of concern in the two countries.

The main problem for the sealing industry in the last 2-3 decades has been the market situation. Protest activities initiated by several Non-governmental Organisations in the 1970s destroyed many of the old markets for traditional seal products which were primarily the skins. The results has been reduced profitability which subsequently resulted in reduction in available harvest capacity (e.g., the availability of ice-going vessels) and effort. With the present reduced logistic harvest capacity in Norway and Russia it is impossible to take out catches that would stabilise the stocks at their present levels. Unless sealing again becomes profitable, it is likely that this situation will prevail.

Recently, however, there have been some indications that the market situtation for traditional seal products is in a process of improvement. An important reason for this is increased prices on some of the skin products, in particular beaters (weaned and moulted harp seal pups) and bluebacks (weaned hooded seal pups). Norwegian sealing has been unprofitable for many years, but to keep the activities alive the authorities has provided some governmental subsidies (14.5 million NOK in 2002). It is, however, the intention that Norwegian sealing shall be normalised such that management and catch activities can be organised according to the same procedures as the fish resources on a commercial basis. A national Marine Mammals Council has been established in Norway – the main objective for this council will be to provide management advice to Norwegian authorities in questions regarding marine mammals, both seals and whales. This establishment is a part of normalisation of the management of marine mammals.

On the Russian side the present harp seal catch logistics in the White Sea implies the use of helicopters. This is very expensive, and future activity will depend very much on increased profitability in the operations. On the Russian side there are now no available ice-going sealers. The possibility to use Norwegian sealing vessels in the White Sea catch has been discussed, but no practical results have been obtained.

The possible change in the market situation may represent a key to how future sealing should be organised. As a result of this, the Joint Norwegian-Russian Fisheries Commission, at its meeting in Kabelvåg, Norway, in November 2002, has recommended that an arena be defined, where experts involved in the various aspects and branches of sealing can meet. This must primarily be a meeting for people from all levels of the sealing industry, including participants with knowledge of both the sealing itself, the products and their application, and the market prospects. Themes addressed should primarily focus on market prospects for traditional products (skins), but also the possibility to introduce "new" products (meat- or blubber-based) on the markets should be assessed.

This was the background for the workshop "Prospects for future sealing activities in the North Atlantic" which will be held at SevPINRO in Archangelsk, Russia on 7 September 2003. The practical arrangements were done jointly by The Norwegian Fishing vessel Owners Association, the Institute of Marine Research in Tromsø, and SevPINRO in Archangelsk. The Joint Norwegian-Russian Fisheries Commission has urged the necessity to secure participation also from other seal hunting nations. For this reason, participation from both Canada and Greenland was secured. The workshop had 39 participants from Canada (1), Greenland (1), Norway (18) and Russia (19).

3.4.2 Workshop program

Opening address (Chairman of the Workshop, director Vasily Zelenkov, SevPINRO, Arkhangelsk, Russia)
The northeast Atlantic seal resources and their role in the ecosystem (Professor Tore Haug, Institute of Marine Research, Tromsø, Norway)
Norwegian sealing: Status and prospects (Tor Are Vaskinn, Tromsø, Norway)
Russian sealing: Status and prospects (Chairman of the Committee of Fisheries Leonid P. Meleshko, Arkhangelsk, Russia)

The status and management of harp and hooded seals in Canada (Dr Garry B. Stenson, Dept. of Fisheries and Oceans, Newfoundland, Canada).
Traditional seal products. Status and prospects seen from Norway/Canada (Director Knut Nygaard, Rieber AS, Bergen, Norway).
Small vessels for use in future Russian coastal fisheries and sealing (Erik Jansen, Solombala Shipyard, Arkhangelsk, Russia / SELFA Arctic, Norway).
New seal products
Current and future exploitation of the seal carcass in Norway (Dr Jan Pettersen, Norwegian Institute of Fisheries and Aquaculture Research, Bergen, Norway)
Products based on simple technology in Norway (Director Arnfinn Karlsen, Polargodt AS, Tjørvåg, Norway)
Russian sealing in the North: Current problems and potential new products (Vitaly Prischemikhin, SevPINRO, Arkhangelsk, Russia)
Discussion
Summary (Professor Tore Haug, Institute of Marine Research, Tromsø, Norway / Director Vasily Zelenkov, SevPINRO, Arkhangelsk, Russia)

3.4.3 Workshop summary

Based on presentations and subsequent discussions, Zelenkov and Haug summarised the workshop as follow:

If profitability in sealing increases, hunting levels are likely to increase up to sustainable levels. It was agreed that this calls for availabilty of updated information about stock status (abundance, productivity and catch statistics), such that catch options can be defined on the best possible basis. Under the precautionary approach, ICES (and NAFO) will not give harvest advice unless such updated information is available. Hunting nations must secure that the stocks are monitored and assessed using accepted methods at regular intervals (no less than every 5 year).

Regulation of the seal populations should be conducted as part of an ecosystem management. Nevertheless, the workshop agreed that seals must be harvested as resources, and not as a pest. Thus, seal resources should be exploited according to the same principles as any other living marine resources.

A more long term strategy for management should be developed. Maybe the approach now under assessment in Canada (with defined biological reference points) can be a way forward.

Hunting methods and the logistics involved is an issue. Russia must change from helicopter-based to boat-based hunting (and the boats must be designed to facilitate participation in other fisheries outside the sealing season), whereas a renewal of the vessel fleet is becoming urgent for Norway. Modernizing of the hunting logistics must take into account that the final design shall be for future sealing (where the whole seal is utilized) and not for the more traditional pelt-blubber and, to a lesser extent, meat sealing.

Self-sustained profitability is a key word for future sealing activities. It is, therefore, necessary to increase the profits of sealing by increasing the value of each seal. This requires that the whole

animal is utilized, and that effort is spent to develop methods to make new products of the parts of the seal that were previously discarded or left on the ice. Exchange of information about the progress in work to develop new products must occur among hunting nations.

New products from sealing is still at an experimental, and not at a large scale, stage. The development of new products must, therefore, occur in parallell with production of more traditional seal products (pelts, blubber, meat). The market situation for certain pelts (in particular bluebacks and beaters, whitecoats are at present uninteresting outside Russia) is improving. Nevertheless, marketing of both traditional and new products will be both necessary and important.

The workshop profoundly encouraged people form sealing nations to cooperate in the future, both on the scientific level (on one side to obtain safe and acceptable assessments and management of the seal stocks; on another side to develop new products), on the industrial level (initiate production of new products, secure sufficient marketing of both new and more traditional products), and among the hunters (renewal of hunting methods and logistics).

Taking into account the recommendations from the workshop, Russia has declared the intent to initiate building of ice-going sealing vessels. Russian sealing operators requires to get the necessary support to entertain future hunting activity. The Working Group **recommends** that similar workshops, with representatives of the sealing industry in the northern region, are arranged on a more regular basis in the future.

3.4.4 Norwegian initiatives to make sealing more effective

To make Norwegian sealing activities more efficient, a decision (made 11 February 2003) to revise and simplify the existing rules and regulations for the practical conduction of sealing were implemented from the 2003 season on.

A Parliamentary White Paper, dealing with marine mammal issues, is currently being prepared in Norway. The Paper, aimed to be presented to and discussed in the Norwegian Parliament in 2004, will define the future Norwegian policy regarding management and exploitation of seals (and whales) in Norwegian and adjacent waters.

4. RESEARCH PROGRAM FOR 2004+

4.1. Norwegian investigations

4.1.1 Collection of biological material from the commercial hunt

Biological material, to establish age distributions in catches as well as reproductive and nutritive status of the animals, will, if practically feasible, be collected from commercial catches in the southeastern Barents Sea in 2004. On a longer term, such data will be collected also in the

Greenland Sea. Data necessary to assess the reproductive status of the harvested seal stocks will also be collected in the near future.

Studies of the ecology of harp and hooded seal pups in the Barents Sea and Greenland Sea will be continued. The long term aim of these investigations is to get a better understanding of the underlaying mechanisms determining the recruitment success from year to year for the two species. The implication of this seal pup project in 2004 is biological sampling from approximately 600 harp seal pups taken in the commercial hunt in the southeastern Barents Sea. Body condition data will also be secured from some of the adult seals taken in the commercial catches.

4.1.2 Estimation of hooded seal pup production in the Greenland Sea

Last time hooded seal pup production was assessed in the Greenland Sea was in 1997. Since abundance estimates of hunted seal stocks should be obtained no less than every 5 year, Norway plan to conduct surveys to obtain data necessary for estimation of the abundance of hooded seals of the Greenland Sea stock in 2005. The methodological approach will be designed along the same lines as the recent (2002) Greenland Sea harp seal survey, i.e., to conduct aerial surveys of pups in the Greenland Sea pack-ice during the whelping period (March-April). A fixed-wing twin-engined aircraft (stationed in Scoresbysound, Greenland) will be used for reconaissance flights and photographic surveys along transects over the whelping patches once they have been located and identified. A helicopter, stationed on and operated from a research vessel, will assist in the reconnaissance flights, and subsequently fly visual transect surveys over the whelping patches. The helicopter will also be used for other purposes (stageing of pups and tagging). As part of the preparations, fuel to be used by the aeroplane must be transported by ship to Scoresbysound the summer before the surveys, i.e., during summer in 2004.

4.1.3 Ecology of harp and hooded seals in the Greenland Sea

A project aimed to provide the data necessary for an assessment of the ecological role of Greenland Sea harp and hooded seals throughout their distributional area of the Nordic Seas (Iceland, Norwegian, Greenland Seas) was conducted in 1999-2002. The field work is now completed, some results are published, and it is the intention that the data shall be subjected to further analyses and prepared for publication in 2004.

4.1.4 Harp seals taken as by-catches in gillnets

Provided harp seals invade the coast of North Norway also during winter in 2004, biological samples will be secured from animals taken as bycatches in Norwegian gill net fisheries.

4.1.6 Seal physiology

On a research cruise to the Greenland Sea in March 2004, the effect of and tolerance to hypoxia in the central nervous tissue of harp and hooded seals will be studied.

4.2.Russian investigations.

4.2.1 Harp seal pup production in the White Sea in 2004

Substantial practical experience in carrying out aerial surveys of harp seal pup production in the White Sea has accumulated in Russia. In 1997 – 2003, 6 aerial photographic surveys were conducted. The results have been reported on a regular basis to WGHARP, and published in Russia and abroad. In 2004, Russia plans to conduct a harp seal pup photography survey and to obtain new data for assessment of the stock. The methodological approach will be similar to previous surveys. Depending on the ice and other conditions, ground truthing necessary to adjust the aerial surveys parameters will also be conducted.

4.2.2. Studies of whelping harp seal in 2004

Biological material for determination of age structure in catches and the reproductive and feeding status of adult females will, if practically feasible, be collected during the 2004 commercial seal hunt. Collection of material on the morphology and ecology of harp seal pups will be continued in the White Sea. Basic attention will be given to such aspects as female breeding terms, time duration of pups in developmental stages, and the beginning of independent feeding. If ice conditions allow, tagging of pups with roto-tags will be conducted. Within the framework of the scientific program it is intended to collect biological samples from 500 adult females and 500 pups of any sex. It is also the intention to continue research on the feeding habits of the seals and their interactions with commercially important fish species.

4.2.3. Studies of harp seals in the 2004 moulting and feeding periods

In April - May 2004, studies of harp seal spring migrations in the White Sea and Barents Sea will be continued.

4.3. Joint Norwegian - Russian investigations

4.3.1 Feeding habits of harp seals in open waters of the Barents Sea

In 2001 and 2002, Norwegian and Russian scientists performed an aerial survey to assess whether there was an overlap in distribution, and thus potential predation, between harp seals and capelin in the Barents Sea. This experiment will now be followed with boat-based surveys aimed to study pelagic feeding by harp seals in the Barents Sea during summer and autum. For various reasons it was not possible to initiate the project in 2003 as planned. However, the project is now planned to run over a three-year period (2004-2006). A first survey to address these questions will take place in May-June 2004. In the Norwegian area (NEZ) a chartered Norwegian coast guard vessel will be used, whereas a Russian vessel will be applied in REZ. There will be a mix of Norwegian and Russian scientific personell on both vessels. The boat-based survey may be supported with aerial reconnaissance surveys performed by a Russian aeroplane.

4.3.2 Tagging of Barents Sea / White Sea harp seals with satellite tags

The successsful joint Norwegian-Russian 1996 project (and a similar project during harp seal breeding in 1995) with tagging of harp seals with satellite transmitters in the White Sea will be continued with final analyses of data and joint publication of results in 2004. The Working Group **recommends** that satellite tagging experiments with harp seals in the White Sea are continued jointly between Norwegian and Russian scientists with the purpose to study distribution, migrations and daily activity of the seals. This will give an important contribution to a better understanding of the temporal and spatial distribution of the seals, which is important input data when their total consumption of marine resources in the Barents Sea is to be assessed. It is important that animals of different sexes and ages are tagged. Preferably, 2004 will be used to select the right tag types, to sort out potential legal problems involved in using this sort of equipment in the White Sea, to define a joint research program that shall ensure a proper design on the experiment, and to secure funding. Deploymnet of tags will be attempted conducted in 2005.

4.3.3 Life history parameters in seals

Upon request, forwarded during meetings of the Joint Norwegian-Russian Fisheries Commission, one Russian scientist was invited to participate in scientific work on Norwegian sealers during March-April in 1997-1999 in the southeastern part of the Barents Sea, and in 2000 in the Greenland Sea. This Norwegian-Russian research cooperation is encouraged, e.g., by extending an invitation to Russian scientists to participate on Norwegian sealers in the southeastern Barents Sea and/or in the Greenland sea also in 2004. This would enable coordinated and joint sampling of biological material. The Working Group **recommend** that Russian scientists are offered the possibility to participate in Norwegian research activities in 2004 as described above. If Russia can realize scientific or commercial vessel trips in the White, Barents and Greenland Seas, invitation for participation of Norwegian scientists is desirable.

From the Russian side it has been suggested that Norwegian and Russian scientists coordinate their research on various biological aspects of the early life phase of seal pups in the White Sea / Barents Sea. Exchange of data and joint publication should be considered. Russian scientists also suggest to repeat previous (1970 – 1980) workshops, where experience of different countries scientists concerning the determination of seal age were exchanged. For this purpose, the use of teeth from seals of known age should be used. As a first step in this activity, one Russian expert were invited to stay in Norway (Tromsø) in January/February 2003 to study the age of harp seals taken in the Norwegian commercial hunt in recent years. The Woorking Group recommend that this sort of activities are continued.

4.4. Necessary research takes

For completion of the proposed Norwegian and Russian research programs, the following numbers of seals are planned to be caught under special permits for scientific purposes in 2004:

Area/species/category	Russia	Norway
Barents Sea / White Sea		
Whelping grounds		
Adult breeding harp seal females	500	0
Harp seal pups	500	0
Outside breeding period		
Harp seals of any age and sex	2000	250
Ringed seals	400	0
Bearded seals	300	0
Greenland Sea*		
Whelping grounds		
Adult breeding harp seal females	500**	25
Harp seal pups	500**	25
Adult breeding hooded seal females	500**	25
Hooded seal pups	500**	25
Outside breeding grounds		
Harp seals of any age and sex	0	100
Hooded seals of any age and sex	0	100
Ringed seals	10*	100
Bearded seals	10*	10

* If Greenland Sea quotas are allocated to Russia, these will be used for collection of biological samples
** Only possible if convenient vessel will be available

5. OTHER BUSINESS

5.1 White whale research

Taking into account the experience stored by Russian and Norwegian experts in studies of white whale abundance, distribution and migrations within the White and Barents Seas, the Working Group **recommends** that Russian and Norwegian scientists unite efforts in developing the techniques for an investigations (including abundance estimation and studies of migration using satellite tags) of white whales in the White Sea. Russian scientists offer Norwegian scientists the opportunity to take part in white whale investigations within the White Sea, as a first stage (2004-2005) to conduct a joint tagging of white whales in the White Sea in the summer season.

5.2 Studies of minke whale ecology

The northeast Atlantic stock of minke whales is known to consume a substantial amount of fish (including commercially important species such as capelin, herring and gadoids). To improve the data base needed to assess the impact of minke whales on the Barents Sea fish stocks, it was suggested at the 2001 meeting of the Joint Norwegian-Russian Fisheries Commission that a research program be developed. In response to this, a joint Norwegian-Russian research program to particularly study the ecology of minke whales in the REZ part of the Barents Sea was developed by professor Tore Haug (Norway) and drs Vladimir Potelov and Vladislav Svetochev (Russia). This would imply a take in REZ of 50 minke whales per year for scientific purposes during the investigation period (2002-2005). Norway has approved such a program, and an application weas sent to Russian authorities to permit two Norwegian whaling boats, each with a Norwegian/Russian scientific crew, to hunt a total of 50 minke whales in REZ in 2002. Russian authorities permitted the Norwegian vessels to into the REZ, but unfortunately they were not allowed to hunt whales. The project therefore had to be cancelled in 2002. A similar procedure were followed in 2003, but with the same result. The Working Group **recommends** that a new attempt to initiate the joint Norwegian-Russian research program on minke whale ecology in REZ is made, and that the program be designed to run over the period 2004-2007.

5.3 Joint whale and other surveys

Traditionally two Russian and two Norwegian research vessels have participated in the Barents Sea capelin survey in September each year. By placing whale observers onboard all four vessels one will gain data on the distribution and abundance on whales relative to the distribution of capelin and other potential prey species. Such data will be very valuable to obtain a further understanding of the role of whale species in the ecosystem, and the Working Group **recommends** that such an observer program is established.

It is also suggested to continue the joint aerial investigations to study distribution and to perform an abundance evaluation of marine mammals and birds in the northern parts of the Barents Sea, including their overlap with fish species such as capelin and polar cod. The investigations will be carried out within the framework of annual surveys of pelagic fishes and have elements of ecosystem approach (September - October).

6. APPROVAL OF REPORT

The English version of the Working Group report was approved by the members on 12 November, 2003.