Appendix 8

THE 34TH SESSION OF THE JOINT NORWEGIAN - RUSSIAN FISHERIES COMMISSION, KALININGRAD, RUSSIA, 24 - 28 OCTOBER 2005

REPORT OF THE WORKING GROUP ON SEALS

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Contents:

1. EXCHANGE OF INFORMATION AND SUMMARY OF SEAL CATCHES IN 2005

Norwegian catches were taken by four vessels in the Greenland Sea and three vessels in the southeastern Barents Sea. For logistical reasons, Russian seal vessels did not carry out hunting in the Greenland Sea in 2005. Russian catches of harp seals in the White Sea were taken by local hunters using helicopters.

The 2005 TACs given for Greenland Sea hooded seals was 5,600 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. ICES had identified the sustainable catch level (that would stabilise the hooded seal population at present level) under a precautionary apporach as 5 600 animals for 2005, however with no multiplier between 1+ animals and pups.

For the Greenland Sea harp seals, the 2005 TAC was set at 15,000 1yr+ animals or an equivalent number of pups (where one 1yr+ animal should be balanced by 2 pups). ICES had identified the sustainable catch level (that would stabilise this population at present level) as 8 200 1+ animals for 2005. The 2005 TAC set for harp seals in the Barents Sea and White Sea was as recommended by ICES (i.e., a level that would stabilise the population at present level) for 2005: 45,100 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).

Norwegian and Russian catches in 2005, including catches under permits for scientific purposes, are summarized in the table below:

Area/species	Norway	Russia	Sum
GREENLAND SEA			
Harp seals			
Pups	4680	0	4680
Older seals (1yr+)	2525	0	2525
Sum	7205	0	7205
Hooded seals			
Pups	3633[1]	0	3633
Older seals (1yr+)	193[1]	0	193
Sum	3826	0	3826
Area subtotal	11031	0	11031
BARENTS SEA / WHITE SEA			
Harp seals			
Pups	1180	14258[3]	15438
Older seals (1yr+)	9386[2]	19[3]	9405
Sum	10566	14277	24843
Area subtotal	10566	14277	24843
TOTAL CATCHES	21597	14277	35874

[1] Include 25 pups and 11 1+ animals taken under permit for scientific purposes in the Greenland Sea
[2] Include 60 animals taken under permit for scientific purposes in summer in the northern Barents Sea
[3] Include 7 200 pups and 19 adult females taken under permit for scientific purposes in the White Sea

2. EXCHANGE OF INFORMATION AND SUMMARY REPORTS OF RESEARCH ACTIVITIES IN 2005

2.1 Norwegian research

2.1.1 Estimation of pup production

From 14 March to 6 April 2002 aerial surveys were carried out in the Greenland Sea pack-ice (the West Ice), to assess the pup production of the Greenland Sea population of harp seals. The total estimate of pup production was 98 500 (SE = 16 800). This is an underestimate due to the presence of unestimated areas along transects during the photographich surveys. Adding the obtained Greenland Sea pup production estimate to recent estimates obtained using similar methods in the northwest Atlantic (in 1999) and in the Barents Sea / White Sea (in 2002), it appears that the entire North Atlantic harp seal pup production, as determined at the turn of the century, is of a magnitude of at least 1.4 million animals per year.

It is recommended that comprehensive aerial surveys needed to provide estimates of current pup production should be conducted periodically (c. every 5 year), and that efforts should be made to ensure comparability of survey results. Therefore, the 2002 surveys in the Greenland Sea (with subsequent laboratory analyses) included participation by Canadian and Russian scientific personell.

The most recent abundance estimate for harp seals in the northwest Atlantic was from 1999. For this reason, new surveys were carried out in March 2004 using an icegoing vessel ('Ann Harvey'), two helicopters and three fixed-wing aircrafts. Norwegian and Russian scientific personell participated in the field work. The survey resulted in an estimated pup production of 991 400 (SE = 58 200). Comparison with previous estimates indicates that pup production has not changed since 1999, likely due to the increased hunting of young animals which began in the mid 1990s.

In the period 11 to 29 March 2005 aerial surveys were performed in the Greenland Sea pack-ice (the West Ice), to asssess the pup production of the Greenland Sea population of hooded seals *Cystophora cristata*. Two fixed-wing twin-engined aircrafts (stationed in Constable Pynt, East-Greenland, and Akureyri, Iceland) were used for reconaissance flights and photographic surveys along transects over the whelping patches. A helicopter, operated from the applied expedition vessel (M/V"Polarsyssel"), assisted in the reconnaissance flights, and subsequently flew combined visual/video transect surveys over the whelping patches. The helicopter was also used for other purposes, such as monitoring the drift of ice and patches, age-stageing (also performed along transects over the patches) of the pups, and assessing the fidelity of pups to their natal ice pans. A total of 15 reconnaissance surveys were flown and the total area along the eastern ice edge between 67°25' and 75°00'N were covered during the survey period. The reconnaissance surveys were usually flown at an altude of approximately 300 m. Repeated systematic east-west

transects spacing10 nautical miles (sometimes 5 nautical miles apart) were flown from the eastern ice edge and usually 10-20 nautical miles (sometimes longer) over the drift ice to the west. Three hooded seal breeding patches were located and surveyed visually (Patches A and B) and photographically (all patches). The aircrafts were equipped with Leica RC 30 cameras with a motion compensation mechanism shooting AGFA Pan 400 black-and-white film. On 24 March, a total of 39 photo transects were flown at an altitude of about 200 m and 979 photos were shot in the three observed whelping patches (A, B, and C) in the area between 71º 09' – 71º 54'N and 15º 23' – 17º 54'W. Only a few whelping hooded seals and pups were observed outside the three surveyed whelping patches. Preliminary results from the aerial surveys indicate that the pup production in 2005 may be considarbly lower than in 1997 which was the most recent (and only) estimate before the 2005 survey. Surveys to determine current pup production of Northwest Atlantic hooded seals were also conducted in March 2005.

2.1.2 Ecological role of hooded seals

To enable an assessment of the ecological role of 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 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 and 2002 (winter). Results from analyses of stomach and intestinal contents from captured seals revealed that the diet was comprised of relatively few prey taxa. The squid *Gonatus fabricii* and polar cod *Boreogadus saida* were particularly important, whereas capelin *Mallotus villosus*, and sand eels *Ammodytes* spp contributed more occasionally. *G. fabricii* was the most important food item in autumn and winter, whereas the observed summer diet was more characterized 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. Samples obtained in more coastal waters indicated a more varied and fish based (polar cod, redfish *Sebasetes* sp., Greenland halibut *Reinhardtius hippoglossoides*) hooded seal diet.

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 has now been analysed along with similar material collected in the period 1992-2001. The bycatches almost eclusively contains mature females. Most probably this is a necessary feeding migration after whelping and an energy-demanding lactation period. In years with good availability of capelin, this species is the dominant harp seal prey. With low capelin availability, the seal diet is still fish based, but more variable including particularly species such as cod *Gadus morhua*, saithe *Pollachius virens* and haddock *Melanogrammus aeglefinus*. Apparantly, the seals were fatter in years with capalin than in years

without this prey item. No sampling from bycatches were conducted in 2005.

2.2 Russian research

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

During the 2005 meeting 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. Estimates from 1998, 2000, 2002 and 2003 have been used in models to assess stock status and to evaluate consequences of various catch options (on a ten year basis) for this stock.

During the 2005 season PINRO employees again executed an aerial count of harp seal pups in the White Sea. For these purposes, the "Arctica" AN-26 plane was used. The survey was made on transects using video and photo equipment, and also with IR-chamber. Data collected during this survey is currently being analysed, and results of the analysis will be presented on the next meeting of WGHARP. Preliminary analysis from similar surveys of harp seal pup production, carried out in 2004 in the White Sea, has now been finished by PINRO and SevPINRO specialists. The analysis of photos has assessed a pup number in 231,812 (SE=44,000), the analysis of all three used sensors has given 234,000 (SE=48,000).

2.2.2 Estimation of number of harp seals on the White Sea moulting grounds

In April 2005, "Arctica" AN-26 was used to attempt to assess the number of harp seals on their moulting grounds in the White Sea. The techniques applied were similar t those used for the estimation of pup numbers. Material collected are being analyzed.

2.2.3 Remote methods for the study of morphological parameters in harp seals

During earlier multispectral aerial surveys of harp seals on breeding grounds in the White Sea, it has been possible to attempt contactless, remote registration of the sizes of adult animals and pups. The method has been based on the use of computer processing and analysis of digital pictures. The approach, if proven successful, may allow for future determination of the size spectrum, and maybe also the age structure, of the stock. Some preliminary results of this work was presented at the WGHARP meeting in 2003 (Arkhangelsk). In 2005 the work was continued, using the data received at the survey of seals on the moulting grounds.

2.2.4. Sampling from commercial and scientific catches

In 2005 biological samples from pups and adult female seals were collected on whelping grounds during commercial and scientific catches in the White Sea. From 3 to 9 March, more than 1800 pups of different sexes and age stages and 19 adult females were examined. The biological material described rates of whelping ground formations during the 2005 season, the morphological parameters of pups in each age stage, and the age structure and morphological

parameters of adult females on whelping grounds. Analysis of feeding data, collected from seal pups at the «beater» stage in 1999-2003 has shown, that harp seal pups in the White Sea cubs, after the termination of milk feeding, do not eat within 2-3 weeks. Independent feeding began in April at the «beater» age stage. The first prey items for the young seals in te White Sea are crustaceans (*Gammaridae*).

2.2.5. Mortality of harp seal pups in the White Sea, June 2005

To study the reasons for and magnitude of harp seal pup mortality in the Dvina gulf of the White Sea during summer, an expedition was conducted. During the period 12 - 16 June 2005, inspection of the entire coastal line of the Dvina gulf (about 90 km shore line) was carried out. A total of 8 dead animals (at variuos age stages) were observed. The principal cause of death was the movement and disintegration of ice on gthe whelping ground. It is supposed, that the observed death rate of pups during their stay in the waters of the White Sea, corresponded with average long-term sizes.The Working Group **recommends** tha Russian scientists continue regular sampling of data from pups and adult seals during commercial catch and from animals taken as by catch in fishing gear in the future.

2.3. Joint Norwegian-Russian work

2.3.1 Abundance estimation

On several occasions the Working Group 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. During the 2004 season, both Norwegian and Russian experts participated in harp seal surveys and some hooded seal research in the Northwest Atlantic. The Working Group **recommend** the continuing exchange of scientists at abundance estimation work of seals.

2.3.2 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 is now being followed with boat-based surveys aimed to study pelagic feeding by harp seals in the Barents Sea during summer and autum, In May/June 2004, and in June/July 2005, Norwegian surveys were conducted, aimed to study the feeding habits of harp seals occurring in the open waters of the Barents Sea. Very few seals were observed along the coast of Finnmark, and no seals were seen in the open, ice-free areas. In the nothwestern parts of the Barents Sea, however, very large numbers of seals were observed along the ice edge and 20-30 nautical miles south of this. In these areas, 33 and 55 harp seals were shot and sampled (stomachs, intestines, blubber cores) in 2004 and 2005, respectively. Additionally,

samples of faeces were taken from the haul out sites on the ice. Preliminary results from the analyses indicate that krill was the main food item for the seals in both years.

2.3.3 Joint seal age estimations

Biological parameters (fertility, mortality, demography) are important input in models used for seal assessments. Data availability is, however, restricted, and it is important to eastablish routines for sampling. A substantial material of teeth (for ageing) has alredy been sampled, both by Norway and Russia, from commercial catches. This material is very useful, and some joint Norwegian-Russian age-reading experiments have been conducted on harp seal teeth. Age estimates of known age teeth (obtained from mark-recapture experiments) 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. To obtain this, and to try to standardise reading between laboratories (in Norway, Russia and other relevant countries such as Canada and Greenland), a joint workshop is planned to be arranged in Norway in 2006.

2.3.4 Joint studies of life history parameters

In the period from 1986 to 1994, Russian scientists collected biological data on hooded seals in the Greenland Sea. Of particular current interest is material which describe the trends in maturity at average age (MAM) for hooded seals, and joint Russian-Norwegian analyses is currenly in progress. The Working Group strongly **recommend** that this material be analyzed and published jointly. As an arena for carrying out of this study, Russian scientists suggest that the Norwegian experts are invited to Archangelsk.

2.3.5 Joint studies of harp seal stock identity

Tissue samples were collected from harp seal pups in the Greenland Sea (50 individuals, taken on Norwegian sealer) and in the White Sea (50 individuals, taken by Russian scientists) in 2005. The samples will be subject to genetic analyses (DNA-based) to adress the question of stock identity in the Northeast Atlantic.

3. STATUS OF STOCKS AND MANAGEMENT ADVICE FOR 2006

WGHARP met at the Department of Fisheries and Oceans (DFO), St.John's, Newfoundland, canada, 30 August-3 September 2005 to assess the stocks of Greenland Sea harp seals, White Sea / Barents Sea harp seals and Greenland Sea hooded seals. Updated information was available for the two harp seal stocks to enable WGHARP to perfrom modelling which provided ICES

with sufficient information (at the ACFM meeting in Copenhagen, Denmark, 6-11 October 2005) to give advice on status and to identify catch options that would sustain the populations at present levels within a 10 year period. A full assessment of the hooded seal stock must, however, await availability of updated abundance estimates (based on surveys conducted in March 2005) and will be performed in 2006.

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 population model that estimates the current total population size. 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. Since the previous assessment (2003), the model used has been modified based upon recommendation from WGHARP. The major difference is that the model now estimates the biological parameters adult and pup mortalities (M_{1+} and M_0) and pregnancy rates (F) rather than using them as fixed input.

The population model estimates the current total population size using historical catch data and estimates of pup production. In principle, the model can also estimate biological parameters (M_{1+}, M_0 and F), but for the populations to which the model is applied there is not enough data to provide accurate estimates of M_{1+}, M_0 and F. To compensate for the lack of data, information from other similar populations are used as input to the model in the form of a prior distribution (mean and standard deviation) for each of the parameter. The same population dynamic model was used for both of the northeast Atlantic harp seal populations, but with stock specific values of prior distributions for M_0, M_{1+} and F. The modications implemented in the model was an improvement from previously used estimation programs. In general the modified model gives higher stock estimates and catch options than the previous model. These differences are primarily due to the change in the estimate of M_{1+} (which was fixed at value which is now regarded to have been to high) and the inclusion of additional sources of uncertainty in the parameters.

The advice given by ICES in 2005 was used by this Working Group on Seals to establish management advice for 2006 to the Joint Norwegian-Russian Fisheries Commission.

3.1. Greenland Sea

The Working Group **recommends** the following opening dates for the 2006 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 2005. 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 2006.

3.1.1 Hooded seals

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

There is not sufficient data to assess the current stock status in an historical perspective. Based on a Norwegian aerial survey in 1997, the stock in 2003 was estimated to be 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).

A new aerial and vessel survey of hooded seal pup production in the Greenland Sea pack-ice was conducted in March 2005. The results will be used to estimate the 2005 hooded seal pup production, but will not be available until 2006. Preliminary results suggest, however, that pup production in 2005 may be considerably lower than observed in the previous survey (1997).

Catch estimation: 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 2001 – 2005)
- Maintenance catches (defined as the fixed annual catches that stabilizes the future 1+ population)
- Two times the maintenance catches.

Formatert: Innrykk: Venstre: 17,85 pt, Hengende: 17,85 pt, Punktmerket + Nivå: 1 + Justert ved: 18 pt + Tabulator etter: 36 pt + Innrykk ved: 36 pt

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 8 years old and there are no estimates of reproductive rates for this stock. Due to this lack of data it is not possible to provide the requested options for this stock.

In the 2003 assessment, ICES recommended an approach based on Potential Biological Removals (PBR). Using this approach, ICES identified an annual catch of 5 600 hooded seals to be the level that would sustain the population at present level. However, given the current poor data availability on this stock and indications that pup production may be reduced, ICES now recommend that management of the stock should be extremely cautious.

The Working Group **recommend** that this ICES advice of cautiousness is implemented in future managenment of hooded seals in the Greenland Sea. Removals should be reduced substantially until more information about current stock status becomes available. It is important to avoid a complete stop in the hooded seal harvest in the Greenland Sea, but the Working Group **recommend that the TAC for this stock should not be higher than 2 400 animals (irrespective of age)** in the 2006 season.

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	58 539	.104
1984	103 250	.147
1985	111 084	.199
1987	49 970	.076
1988	58 697	.184
1989	110 614	.077
1990	55 625	.077
1991	67 271	.082
2002	98 500	.179

As well as these pup estimates the model includes age at maturity and estimates of natural mortality and natality. Based on these inputs the model estimated the following 2005 abundance for Greenland Sea harp seals: 618 000 (95% C.I. 413 000-823 000) 1+ animals with a pup production of 106 000 (95% C.I. 71 000-141 000).

Based on a request from Norway, ICES gave **catch options** for three different catch scenarios:

- Current catch level (average of the catches in the period 2001 – 2005)
- 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 2015 and 2005 is used.

10 Year Projection

Option #	Catch level	Proportion of 1+ in catches	Pup catch	1+ catch	$N_{2015,1+}$ / $N_{2005,1+}$
1	Current	25.6% (current level)	3 303	1 138	1.51 (1.18-1.83)
2	Sustainable	25.6%	36 688	12 624	1.01 (0-61-1.41)
3	Sustainable	100%	0	31 194	1.05 (0.66-1.44)
4	2 X sust.	25.6%	73 376	25 248	0.45 (0.00-0.97)
5	2 X sust.	100%	0	62 388	0.55 (0.06-1.03)

While current catch level (option 1) will likely result in an increase in population size, ICES emphasized that a catch of 31 194 1+ animals (catch option 3), or an equivalent number of pups, in 2006 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 2006:
31 200 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 45-55% 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 28 February to 15 May for Russian coastal and vessel catches and from 23 March to 15 May for Norwegian sealing ships. 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 2006.

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. There are reports that pup mortality rates may vary substantially in the White Sea region, and that in recent years these rates have been very high. For this reason, the 2005 abundance of White Sea harp seals was estimated under the assumption that the ratio between the natural mortality of pups and adults was 5 instead of 3.

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	325 643	.111
2000	339 710	.095
2002	330 000	.103
2003	327 000	.125

For 2000 there are two independent estimates for pup production.

As well as these pup estimates the model includes age at maturity and estimates of natural mortality and natality. Based on these inputs the model estimated the following 2005 abundance of harp seals in the White Sea: 2 065 000 (95% C.I. 1 497 000-2 633 000) 1+ animals with a pup production of 361 000 (95% C.I. 299 000-423 000).

Aeroplane surveys of White Sea harp seal pups were conducted also in March 2004 and 2005 using traditional strip transect methodology and multiple sensors. Results obtained in the 2004 surveys were negatively biased due to late and incomplete coverage, whereas the results from the more successful 2005 survey are still being analysed.

Based on a request from Norway, ICES gave **catch options** for three different catch scenarios:

- Current catch level (average of the catches in the period 2001 – 2005)
- 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 2015 and 2005 is used.

					10 Year Projection
Option #	Catch level	Proportion of 1+ in catches	Pup catch	1+ catch	$N_{2015,1+}$ / $N_{2005,1+}$
1	Current	11.5% (current level)	25 945	3 371	1.35 (0.91-1.78)
2	Sustainable	11.5%	153 878	19 995	0.98 (0.57-1.39)
3	Sustainable	100%	0	78 198	1.04 (0.62-1.50)

4	2 X sust.	11.5%	307 756	39 990	0.53 (0.12-0.93)
5	2 X sust.	100%	0	156 396	0.67 (0.24-1.10)

While current catch level (option 1) will likely result in an increase in population size, ICES emphasized that a catch of 78 198 1+ animals (catch option 3), or an equivalent number of pups, in 2006 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 White Sea / Barents Sea in 2006:
78 200 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 2.5 pups.
Catches 2X sustainable levels (options 4 and 5) will result in the population declining by approximately 53-67% in the next 10 years.

3.2.2 Other species

The Working Group agreed that commercial hunt of bearded seals should be banned in 2006, as in previous years, but it **recommend** to start catch under permit for scientific purposes to investigate results of long time protection.

3.4 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. The suggested conceptual framework for applying the PA to Atlantic seal management requires that data rich and data poor stocks be treated differently when biological reference points are to be defined. Data adequate stocks should have data available for estimating abundance where a time series of at least five abundance estimates should be available spanning a period of 10-15 years with surveys separated by 2-5 years, the most recent abundance estimates should be prepared from surveys and supporting data (e.g., birth and mortality estimates) that are no more than 5 years old, and the precision of abundance estimates should have a Coefficient of Variation about the estimate of about 30%. Stocks whose abundance estimates do not meet all these criteria are considered data poor.

Based upon these criteria, the Greenland Sea hooded seal stock should be considered data poor. Although reproductive data for the Greenland Sea harp seal stock needs to be updated, there are

sufficient pup production estimates to consider this stock data adequate. There have been 5 pup production surveys since 1998 in the White Sea. The quality of the pup surveys is sufficient to consider the stock data adequate. However, as for the Greenland Sea, reproductive data for this stock is not current. Recent reproductive data are required for both of these stocks to maintain these classifications.

For a data adequate species, a framework including two precautionary and one conservation (limit) reference level are proposed (Fig. 1). All reference levels relate to the pristine population size, which is the population which would be present on average in the absence of exploitation, or a proxy of the pristine population (e.g. maximum population size historically observed, N_{max}). A conservation or lower limit reference point, N_{lim}, identifies the lowest population size which should be avoided with high probability. Between those points it is suggested that two precautionary reference points are used as decision signposts for increasingly restrictive management to be introduced when the population approaches the conservation limit. In accordance with practices in the Western Atlantic ICES recommends that the limit reference point (N_{lim}) could be either 30% of the historical accurate maximum population estimates or should be set independently using IUCNs vulnerable criteria.

The first precautionary reference level could be established at 70% (N_{70}) of $N_{max.}$ When the population is between N_{70} and N_{max}, harvest levels may be decided that may stabilise, reduce or increase the population, so long as the population remains above the N_{70} level. When a population falls below the N_{70} level, conservation objectives are required to allow the population to recover to above the precautionary (N_{70}) reference level. N_{50} is a second precautionary reference point where more strict control rules must be implemented, whereas the N_{lim} reference point is the ultimate limit point at which all harvest must be stopped.

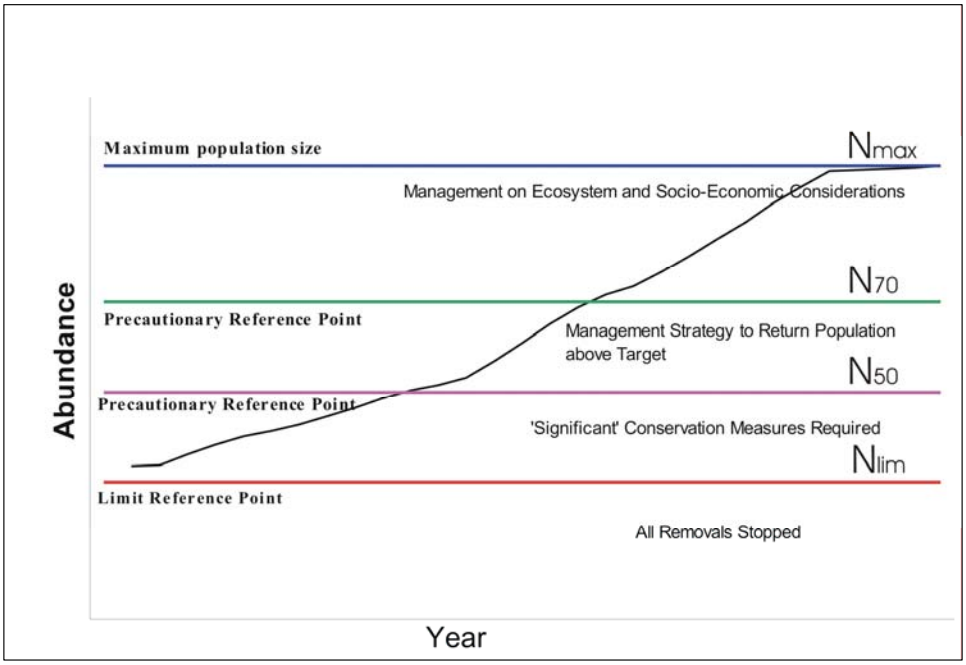

Figure 1 Reference points for a data rich stock.

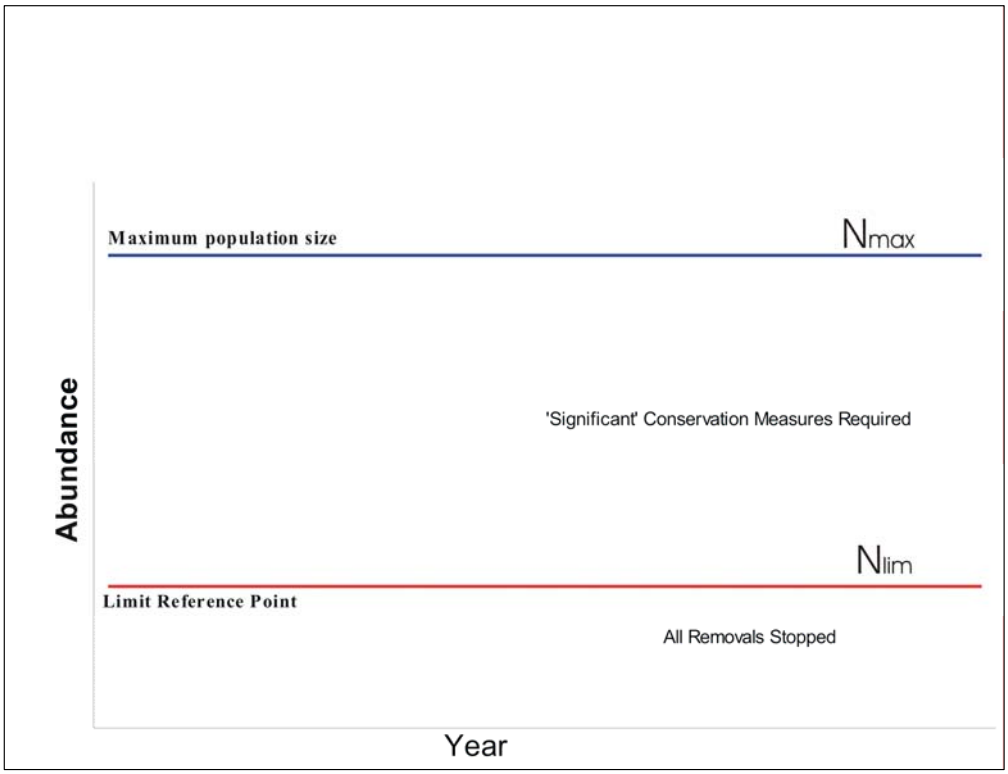

Figure 2 Reference points for a data poor species.

For data poor stocks, it is recommended that only the lower tier (below N_{lim}) be defined (Fig. 2). In this case, the four tiers effectively collapse to two (i.e., above and below N_{lim}). Below N_{lim} all harvest must be stopped, and conservative and effective management measures will at all times be required when the stock is below N_{max}.

Presently the time series only covers period with significant hunting pressure. The hunting pressure has been reduced in the last decades resulting in an increase in the populations since the 1970s. As a result ICES consider that the harp seal populations are presently at their highest historical level (for the time series since the 1940s) and the present exploitation is expected to allow a continuation of population increase. It is not presently possible to evaluate possible density dependent effects on mortality, growth or reproduction which will emerge in the event that the stocks would grow to larger sizes than have been observed historically, approaching the carrying capacity of the environment. It is therefore not possible to estimate the carrying capacity or pristine stock or proxies such as N_{max}. It is a further complication that the carrying capacity will be variable dependent on changes in the ecosystem and an estimation of pristine stock would therefore need to take such events into account. Examples of such changes could be changes in

climatic conditions, in size of prey stocks, and in diseases. A framework based on reference points relating to pristine stock as outlined above can therefore not be applied with the present knowledge about the dynamics of these populations.

In the absence of a historical time series which enables estimates of N_{max} ICES suggest as an interim solution that a risk avoidance management strategy is implemented. The stocks of harp seals in the Greenland Sea and White Sea / Barents Sea have increased continuously from historical minimum levels in the 1960s. The populations have thus demonstrated an ability to grow from the historical minimum populations in the 1960s whereas the dynamics for populations below that size is unknown. As a precautionary management approach it is therefore suggested that management is implemented such that the populations are above the historical minimum populations with high probability. Recent abundance estimates implies that present populations are above historical minimum with high probability. Maintaining the populations at or above the present level will thus be in accordance with precautionary management.

3.5 Prospects for future sealing activities

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 have 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.

It is the opinion of the Working Group that future sealing activities must be profitable. If sealing profitability increases, hunting levels are very likely to increase up to sustainable levels. 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). The Working Group feels that both countries now contribute acceptably to this in that Russian scientists estimates the abundance of White Sea harp seals annually, whereas Norway aims to estimate Greenland Sea harp and hooded seals regularly, preferably with no more than 5 years between each survey. Greenland Sea harp seals were surveyed in 2002, hooded seals in 2005.

Regulation of the seal populations should be conducted as part of an ecosystem management. Nevertheless, 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. In an ecosystem context, harp seals are most important. This is the most numerous seal species, and it is regarded as a predator of concern in assessments of both capelin and cod/haddock in the

Barents Sea. In the report from the Basic Document Working Group, necessary reasarch activities, to improve the basis for inclusion of harp seal predation in fish stock assessments and management, is identified. The Working Group notice that some of this work has already started (collection of diet data), and **recommend** that this work continues, and that necessary telemetric studies of the species are also started in 2006.

The Working Group noted that ICES is currently working to develop biological reference points for harp and hooded seals. Most likely, such reference points can be developed soon for all harp seal populations, whereas for hooded seals this must await availability of updated abundance estimates. The Working Group **recommend** that these reference points be used in the long term strategy for management of harp and hooded seals.

The Working Group appreciated Russian plans to change from helicopter-based to boat-based hunting. The boats must be designed to facilitate participation in other fisheries outside the sealing season. Increased profitability is necessary to make this change in sealing logistics and methodology feasible. This is also necessary to enable an urgent renewal of the Norwegian vessel fleet – this process is now in progress. To assure self-sustained profitability in future sealing activities, the Working Group concluded that it would be necessary to increase the profits of sealing by increasing the value of each seal. The Working Group does not see any ecological problems if only parts of the seal is used, i.e., that only pelts and blubber are taken, while the rest of the carcass is left on the ice to be recycled in the ecosystem. It is, however, preferable 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 is otherwise discarded. When seal meat is taken for human consumption, the production lines onboard the vessels must meet the usual standards for food production. The Working Group empasize that sealing is restricted to a relatively short period during spring – new sealers must, therefore, be designed in such a way that they can be used also in other fisheries.

A new (for sealing) resource tariff was imposed upon the sealing activities in Russia in 2004. As a result there were no sealing in Russia in 2004 and reduced activity in 2005. The Working Group has been very concerned about this situation, and has **recommended** that Russian management authorites secures that profitable sealing can continue in the White Sea also in the future. Due to the extreme importance of sealing for the communities around the White Sea, it now seems that the imposed resource tariff can be appropriately reduced such that sealing can be resumed at a more traditional scale in 2006. The Working Group appreciate this initiative.

4. RESEARCH PROGRAM FOR 2006+

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 be collected from commercial catches both in the southeastern Barents Sea and in the Greenland Sea in the future. In 2006, sampling will be performed from

commercial vessels in the southeastern Barents Sea.

Studies of the ecology of harp and hooded seal pups in the Barents Sea and Greenland Sea will be continued as well. 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. Sampling is performed on commercial vessels – next effort will be in the southeastern Barents Sea in 2006.

4.1.2 Estimation of harp seal pup production in the Greenland Sea

Last time harp seal pup production was assessed in the Greenland Sea was in 2002. Since abundance estimates of hunted seal stocks should be obtained no less than every 5 year, Norway will conduct surveys to obtain data necessary for estimation of the abundance of harp seals of the Greenland Sea stock in 2007. The methodological approach will be designed along the same lines as the previous 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 was transported by ship to Scoresbysound during summer in 2006.

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 2006.

4.1.4 Harp seals taken as by-catches in gillnets

Provided harp seals invade the coast of North Norway also during winter in 2006, 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 2006, various physiological parameters of harp and hooded seals will be studied.

4.2.Russian investigations

4.2.1 Harp seal pup production in the White Sea in 2006

Substantial practical experience in carrying out aerial surveys of harp seal pup production in the White Sea has accumulated in Russia. In 1997 – 2005, 8 aerial photographic surveys were conducted. Russia aims to get these surveys annual. The results have been reported on a regular basis to WGHARP, and published in Russia and abroad. To carry out this work, the "Arctica AN 26" plane will be used. The plane will be based in Archangelsk, and the metdological approach will be as in previous years. In 2006, 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 2006

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 2006 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. 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 2006 moulting and feeding periods

In April - May 2006, studies of harp seal spring migrations in the White Sea and Barents Sea will be continued. In April 2006 a full-scale surveys of the harp seals on their moulting grounds in the White Sea will be attempted conducted.

4.2.4 Investigations of harp seals taken as by-catches in gillnets

In case of mass approaches of harp seal in May-June 2006 to coastal areas of the White Sea, biological samples will be secured from animals taken as bycatches in Russian gill net fisheries.

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 is now being 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, so the first survey to address these questions took place in May/June 2004. The project is planned to run over a three-year period (2004-2006), and the next survey to address these questions will take place in June 2006. In the Norwegian area (NEZ) a research vessel ("Jan Mayen") will be used. This will

enable synoptic sampling of seals and prey abundance data. A Russian vessel will be applied in REZ. If possible, 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 successful 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 is planned to be continued with final analyses of data and joint publication of results in 2006. 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. In 2004 a joint research program (written by Drs Arne Bjørge, Mette Mauritzen and Vladislav Svetochev) that ensures a proper design on the experiment, has been developed. The program describes the background for the project, the types of equipment to be used, how the field work will be caried out, and the total costs. The program is assumed to run for 5 years, with 15 tags being deployed every spring (i.e., immediately after the moulting period). First deployment of tags will be conducted in the White Sea in 2006. It is important that both young immature seals and adults are tagged each year. If it proves difficult to obtain young seals in the White Sea, some of the tags could alternatively be deplyed on young animals during the “Jan Mayen” survey in the northern Barents Sea in June 2006.

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 the future. 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 2006. 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 Working Group **recommend** that this sort of activities are continued.

4.3.4 Seal food consumption

Important data on ringed seal feeding in the White Sea and Kara Sea areas has been collected in Russia. Realizing the importance of true seals feeding, including the harp seal, Russian researchers invite to organize a symposium, in which experts from Russia and Norway could attempt unification in the collection of feeding components of the true seals, and to discuss the questions of seal energy consumption. The Working Group **recommend** to carry out such work. Such a workshop could be held in Archangelsk, with the invitation of Norwegian experts.

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 2006:

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	2300	250
Ringed seals	70	50
Bearded seals	35	50
Greenland Sea*		
Whelping grounds		
Adult breeding harp seal females	500**	100
Harp seal pups	500**	100
Adult breeding hooded seal females	500**	100
Hooded seal pups	500**	100
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

During 2005, Russian scientists have been capturing and tagging (by satellite transmitter) one white whale in the White Sea. Difficult weather conditions and features of animal distribution in area of their capture only permitted the catching and tagging of one single animal. Information about the positioning of the tagged animal positions continues to be received. At continuation of the studies, it is necessary to increase the number of tagged whales, and to develop new techniques of white whale capturing in various areas of the White Sea. When carrying out the capture of white whales during the 2006 season it is planned to collect samples for determination of population discontinuity within the limits of the White Sea and for organism pollution levels. In 2006 it is planned to capture and sample 20 animals. The Working Group **recommends**, that the program of white whale investigations in the White Sea be continued also during the 2006 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 was 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 go into the REZ, but unfortunately they were not allowed to hunt whales. The project therefore had to be cancelled in 2002. Similar procedures were followed in 2003-2005, but with the same results. 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 2006-2009.

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. A first effort was done in 2004 when this survey was run as an ecosystem survey for the first time. New sampling were performed in 2005. Data colllected are being analysed. The Working Group **recommends** that this observer program is continued.

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 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). The Working Group appreciate this activity, and also **recommend** that studies of diet of other seal species such as ringed seals, bearded seals and grey seals are undertaken to assess their impact on stocks of commercial fishes.

5.4 Studies of ringed seal ecology in the Kara and Laptev Seas

In 2005 Russian scientists have begun a project to collect new data for an assesment of the ecological role of ringed seal in the Kara Sea. Field work are completed, and results will be analyzed. It is supposed that data will prepared for publication in 2006-2007. In 2006 Russian researchers plan to continue the ecological investigations of ringed seals in the Kara Sea, and also to prepare a program to study the ecological role of ringed seals in the Laptev Sea with initiation of the program in 2007. The Working Group **recommends** that the planned studies be executed in 2006 and 2007.

6. APPROVAL OF REPORT

The English version of the Working Group report was approved by the members on 27 October, 2005.