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North Atlantic Marine Mammal Commission

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MEETINGS & OFFICE BEARERS 2002

Members of the Commission		**Councillors**
Faroe Islands	(F)	Mr Kaj P. Mortensen
Greenland	(G)	Mr Einar Lemche
Iceland	(I)	Mr Stefan Asmundsson
Norway	(N)	Mr Johán H. Williams

Council

Chairs –	*1992-95*	Mr Kjartan Høydal (F)
	1995-97	Mr Halvard P. Johansen (N)
	1997-99	Mr Arnór Halldórsson (I)
	1999…	Ms Amalie Jessen (G)

NAMMCO/12 – Twelfth Meeting of the Council, 4 - 6 March 2003, Asker, Norway

Committee on Hunting Methods

Chairs –	*1994-98*	Ms Amalie Jessen (G)
	1998…	Mr Jústines Olsen (F)

Management Committee

Chairs –	*1993-94*	Mr Kjartan Høydal (F) interim
	1994-98	Mr Einar Lemche (G)
	1998…	Mr Kaj P. Mortensen (F)

Eleventh Meeting of the Management Committee, 5 March 2003, Asker, Norway

Management Committee Working Group on Inspection and Observation

Chairs –	*1993-95*	Mr Einar Lemche (G)
	1995…	Dr Egil Ole Øen (N)

Management Committee Working Group on By-catch

Chairs –	*1998-99*	Mr Gísli A. Víkingsson (I)
	1999-2003	Dr Arne Bjørge (N)
	2003….	Mr Kim Mathiasen (G)

Scientific Committee

Chairs –	*1993-95*	Mr Jóhann Sigurjónsson (I)
	1995-97	Prof. Tore Haug (N)
	1997-2000	Dr Mads Peter Heide-Jørgensen (G)
	2000 ...	Mr Gísli A. Víkingsson (I)

Tenth Meeting of the Scientific Committee, 17 -19 September 2002, Hvalfjörður Whaling Station, Iceland

Scientific Committee Working Group on Management Procedures

Chair –	*1993…*	Dr Nils Øien (N)

Scientific Committee Working Group on Abundance Estimates

Chair –	*1996…*	Dr Nils Øien (N)

Scientific Committee Working Group on the Economic Aspects of Marine Mammal – Fisheries Interactions

Chairs –	*1998-99*	Dr Gunnar Stefánsson (I)
	1999-2000	Mr Aqqalu Rosing-Asvid (G)
	2000 …	Prof. Lars Walløe (N)

Scientific Committee Working Group on the Population Status of Narwhal and Beluga

Chair –	*1999…*	Prof. Øystein Wiig (N)

Scientific Committee Working Group on the North Atlantic Fin Whales

Chair –	*1999…*	Mr Gísli A. Víkingsson (I)

Finance and Administration Committee

Chairs –	*1999-2000*	Mr Øyvind Rasmussen (N)
	2000 …	Mr Einar Lemche (G)

The NAMMCO Fund

Chairs –	*1998-2000*	Ms Ulla S. Wang (F)
	2000-2001	Ms Kate Sanderson (F)
	2001…	Ms Ulla S. Wang (F)

Secretariat

General Secretary	Dr Grete Hovelsrud-Broda
Scientific Secretary	Mr Daniel Gordon Pike
Administrative Co-ordinator	Ms Charlotte Winsnes

SECTION 1 - COUNCIL

1.1
REPORT OF THE TWELFTH MEETING OF THE COUNCIL

Asker, Norway 4 – 6 March 2003

The NAMMCO Council held its 12th Meeting at the Leangkollen Hotel in Asker, Norway 4 – 6 March 2003. The meeting was attended by delegations from all Contracting Parties, the Faroe Islands, Greenland, Iceland and Norway, as well as observers from the Governments of Canada, Denmark, Japan and the Russian Federation. A number of intergovernmental and non-governmental organisations were also represented at the meeting. See Section 5.5 for The List of Participants.

The Chair of the Council, Amalie Jessen convened the meeting.

1. OPENING PROCEDURES

1.1 Welcome Address

The General Secretary to NAMMCO Dr Grete Hovelsrud-Broda welcomed the participant to Asker, Norway. The address is contained in Appendix 3. The Scientific Secretary, Mr Daniel Pike gave a presentation to the meeting on the North Atlantic Sighting Survey. In his address Mr Pike presented the development and history of the sighting surveys and noted that these surveys provide a unique source of information on the distribution, abundance and trends in abundance of several whale stocks. This information is crucially important in the management of whale stocks throughout the North Atlantic, and also in the assessment of their role in the ecosystem. A summary of the address is included in Appendix 3.

1.2 Opening Statements

The heads of the delegations of Greenland, the Faroe Islands, Iceland and Norway made opening statements to the meeting. In addition, the observer from the Government of Japan circulated an opening statement to the meeting. These statements are included in Appendix 3.

1.3 Admission of Observers

On behalf of the Council, the Chair welcomed the observers from governments, intergovernmental and non-governmental organisations.

The Secretary informed the Council that the following had sent their regrets in not being able to attend NAMMCO/12: the Arctic Council, the Convention on Conservation of Migratory Species of the Wild (UNEP/CMS), the Food and Agriculture Organisations of the UN (FAO), International Council for the Exploration of the Sea (ICES), the North Atlantic Salmon Conservation Organisation (NASCO), the World Conservation Union (IUCN), and Resource Africa.

1.4 Adoption of Agenda

The agenda as contained in Appendix 1, was adopted.

1.5 Meeting Arrangements

The Secretary outlined the practical and social arrangements for the meeting, and on behalf of NAMMCO invited the participants to a dinner hosted jointly by NAMMCO and the Norwegian Ministry of Fisheries.

The list of documents presented to the meeting is contained in Appendix 2.

2. FINANCE AND ADMINISTRATION

2.1 Report of the Finance and Administration Committee

The Chairman of the Finance and Administration Committee, Einar Lemche (Greenland) presented the report to the Council.

The Finance and Administration Committee held four meetings in 2002/2003. The tasks of the Committee were to review audited accounts for 2001, to develop a draft budget for 2003 and a forecast budget for 2004 (see under item 2.2). The Finance and Administration Committee had received a preliminary spending authorisation from the Council for 2003, awaiting the Council's approval of the draft budget for 2003 at its 12th Meeting 4-6 March 2003 (see under item 2.2). The reports of the Committee were available to the meeting as document NAMMCO/12/4.

2.1.1 Staff Rules Revisions

The Council **adopted** the revisions to the Staff Rules for the Secretariat, as recommended by the Committee. The revisions pertain to the Staff Rules Article 8 first paragraph dealing with annual leave, and will harmonise the NAMMCO Staff Rules with the Norwegian system for *Feriepenger* (payment during annual leave).

The Council **adopted** the recommendations by the Committee to acknowledge that NAMMCO employees are protected under Norwegian employment laws and to revise the Staff Rules to reflect the rights of NAMMCO employees.

2.1.2 Budget Pre-Approval

The Council **adopted** the recommendation by the Committee to approve on a preliminary basis budgets a year in advance in order to avoid seeking preliminary spending authorisation.

2.1.3 Contribution Adjustments

The Council noted that the budget and the member contributions had not been adjusted for inflation since the implementation of the Host Agreement. The Council **adopted** the recommendation by the Committee that member contributions are adjusted for inflation annually in accordance with official Norwegian inflation figures.

2.2 Commission Budget 2003, Forecast Budget 2004, Final Accounts 2001, and 2002

2.2.1 Final Accounts 2001 and 2002

The Council noted that the Finance and Administration Committee in a meeting in September 2002 and in a telephone meeting in February 2003 had reviewed the final

audited accounts of the Commission for 2001 and 2002. The Council formally approved the accounts for 2001 and 2002 (see Appendix 4).

2.2.2 Commission Budget 2003

The Council **adopted** the budget for 2003, as contained in NAMMCO/12/4 Annex 1 rev.1 and as recommended by the Finance and Administration Committee.

The Council noted that the member contributions had been adjusted for inflation following official Norwegian inflation rates, and that some funds from the General Reserve had been utilised to balance the budget. The Council noted the recommendation from the Committee that the General Reserve should be kept at a minimum of 100,000 NOK in any given year.

2.2.3 Forecast Budget for 2004

The Council **agreed** to allocate 200,000 NOK to the planned Workshop on Hunting Methods for Seals and Walrus, but emphasised the need to seek funding from other sources.

The Council **adopted** on a preliminary basis the forecast budget for 2004, as contained in NAMMCO/12/4 – Annex 1 rev1.

3. SCIENTIFIC COMMITTEE

3.1 Report of the Scientific Committee

Gísli A. Víkingsson, Chair of the Scientific Committee, presented the Report of the 10th Meeting, which was held 17-19 September at the whaling station at Hvalfjörður, Iceland. The full report is included in Section 3 of this volume.
National Progress Reports for 2000 from the Faroe Islands, Greenland, Iceland and Norway were submitted to the Scientific Committee, and are included in Section 4 of this volume.

3.1.1 Co-operation with other organisations

Scientific Committee of the International Whaling Commission
The 54th meeting of the Scientific Committee of the International Whaling Commission was held in Shimonoseki, Japan, from 25 April to 11 May. Daniel Pike attended as observer for the NAMMCO Scientific Committee.

An Implementation Review for North Atlantic minke whales was scheduled for this year. However the Norwegian authorities were not able to provide the required data and estimates of abundance for Northeast Atlantic minke whales 3 months in advance of the Scientific Committee meeting, as stipulated under the Revised Management Procedure. Therefore the Implementation Review will be continued in 2003.

The comprehensive assessment of North Atlantic humpback whales was begun last year. It could not be completed then because the assessment model used could not resolve apparent inconsistencies between the historical catch and abundance data in some areas. The assessment was continued using new data on historical catch, and

new information on abundance and trends in abundance from the NASS around Iceland. However the new assessment model was again unable to reconcile all the available data. The Committee considered that and increase in the take by St Vincent and the Grenadines from 2 to 4 whales was unlikely to have an impact on the population, assuming that the whales found in the Eastern Caribbean are part of the West Indies breeding stock.

Survey reports from the NASS-2001 shipboard and aerial surveys around Iceland were presented to the Committee. In addition, abundance estimates for fin whales and sperm whales were presented. The Committee did not have time to fully consider these reports.

The Committee selected a strike limit algorithm (SLA) for the Bering-Chukchi-Beaufort bowhead whale stock. The Committee is now moving ahead with trials of SLA's developed for Eastern Pacific grey whales.

Dr Douglas DeMaster (USA) was chosen as Chair, and Dr Arne Bjørge (Norway) was chosen as Vice-Chair. A more detailed report from the meeting is included in Section 3.

ICES

The Scientific Committee continues to use the reports of the Joint ICES/NAFO Working Group on Harp and Hooded seals as the basis for their advice on these species, and the Working Group will meet again early in 2003.

The ICES Working Group on Marine Mammal Population Dynamics and Habitats (WGMMPH), met in May 2002 by correspondence to develop further the basis for advice on cetacean bycatch and bycatch mitigation measures in European Union fisheries. Information on by-catches of cetaceans in various gear types was reviewed and possible limitations in use of gear and time/area closures discussed. Questions concerning the use of pingers, gear modifications, and other mitigation measures were addressed. WGMMPH will meet again in March 2003 to address issues such as by-catches of marine mammals in fisheries, the role of seal epizootic events in population regulation, census techniques used in seal abundance estimation, and the effects of expanding seal populations.

The Scientific Committee noted the continuing overlap of interests between the NAMMCO and the ICES, particularly with regard to harp, hooded and grey seals, and bycatch issues with small cetaceans, and urged scientists from member countries to participate in the ICES working groups to the extent feasible. The Council **endorsed** this recommendation.

Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga

Neither the Joint Commission nor the Scientific Working Group has met since the last meeting of the Scientific Committee.

3.1.2 Modelling marine mammal - fisheries interactions in the North Atlantic

At its 8th meeting, the NAMMCO Council tasked the Scientific Committee with providing advice on the economic aspects of marine mammal-fisheries interactions. A Working Group on the Economic Aspects of Marine Mammal - Fisheries Interactions met in February 2000 to consider parts of the request. One of the conclusions of the Working Group was that significant uncertainties remain in the calculation of consumption by marine mammals, and this uncertainty was the most important factor hindering the development of models linking consumption with fishery economics (NAMMCO Annual Report 2000, pp. 123-296). Considering this conclusion, the Scientific Committee decided to convene a workshop to further investigate the methodological and analytical problems in estimating consumption by marine mammals. This workshop was held in Tromsø in September 2001 and resulted in, among other things, a list of research priorities to refine existing estimates of consumption by North Atlantic marine mammals (NAMMCO Annual Report 2001, pp. 147-272).

The Scientific Committee viewed the next logical step in this process to be a review of how presently available ecosystem models can be adapted in order to increase our understanding of and quantifying marine mammal - fisheries interactions. The Workshop was held in Reykjavik in September 2002. It was tasked with choosing a preferred modelling approach for analysing the ecological role of minke whales, harp and hooded seals, and other marine mammal species in the North Atlantic, identifying required input data, and recommending a process for further development. The Working Group was not expected to review results or make quantitative predictions at the meeting, but rather to focus on methodological problems.

<u>Available multi-species models</u>

The Working Group considered descriptions of the range of available multi-species modelling tools. This includes two general classes of models typified by the Minimum Realistic Models (MRM) on the one hand and the ECOSIM/ECOPATH approach on the other. The MRM class includes MULTISPEC, BORMICON/GADGET and Scenario Barents Sea. These models share the characteristics of being system specific, modelling only a small component of the ecosystem for a specific purpose, and treating lower trophic levels and primary production as constant or varying stochastically. In contrast, ECOPATH/ECOSIM is an all-inclusive approach that incorporates lower trophic levels and primary production.

<u>Recommended modelling approach for the NAMMCO</u>

Considering the data available or likely to become available in the foreseeable future, the Working Group favoured the approach of using a MRM that encompassed only the major species of interest. The Working Group considered that the ECOPATH/ECOSIM package, while providing a viable framework for some types multi-species modelling, was not entirely suited to the usage envisioned by the NAMMCO. Potential disadvantages discussed included the in-built functional forms for species interactions, and simplified treatment of age-structure, that may not be appropriate for the particular cases to be considered. Another problem is the large number of parameter values that need to be specified; some of these may have an

appreciable impact on outputs, and the default suggestions provided by the package may not be the most appropriate in all circumstances.

Some members voiced the concern that the development of ecosystem models without sufficient data in some components would produce results that might be used inappropriately by managers, who might not understand the level of uncertainty in the results even if it is specified. However it was agreed that the two activities should proceed simultaneously: that is, the data gaps identified should be filled by dedicated studies, while modelling can proceed in candidate areas, even with partial data, as long as the uncertainty of the results is emphasised and integrated in the results. In this way, modelling approaches can be refined and the reliability of the results will improve as more data is gathered.

There was agreement that the continued development of the Scenario Barents Sea model should be a priority, with emphasis on incorporating the predation of harp seals in the model. In addition the Working Group recommended the development of a second, more general North Atlantic "template" model based on the GADGET platform. This spatially homogeneous model would include species important in candidate applications to West and East Greenland, Iceland and the Barents and North Seas. However the abundance of these species would be varied between the areas according to available information. In areas where data is lacking, such as West Greenland, the main use of such a model will be to identify the sensitivities to variation in input parameters, and thus to assist in the setting of priorities for research. In Icelandic waters, where better data is available for fish but data on marine mammal diets and prey selection are scarce, such a model will serve the same purpose but also generate preliminary scenario results for management. For the relatively data-rich Barents Sea area, the model will augment the main Scenario Barents Sea modelling effort.
In reviewing the amount of multi-species modelling work and associated applications to management decisions that had been conducted world-wide over the past several years, the Working Group noted a much lower than expected activity in this area. This was considered surprising given the emphasis politicians and management authorities have placed on multi-species (ecosystem) approaches to the management of marine resources. While the principle of multi-species management seems to be widely accepted, the practical aspects of putting it into practice lag far behind the rhetoric. The Working Group emphasised that progress in this area will not be made unless significant additional resources are dedicated to it.

It was considered that discussion of the economic aspects of marine mammal-fisheries interactions would be premature until at least one of the two models above has been developed. Once models are available that can predict the variation in target species in response to management measures, linkages to simple economic models that assess the economic consequences of the responses can be made.

The Scientific Committee considered that it may have identified a way forward in addressing the requests from the Council, but stressed the importance of completing the necessary modelling work and collection of required input data before further

progress on this matter can be made. For the modelling work, further progress cannot be made outside of the Barents Sea candidate area without additional resources, and the modelling effort for the Barents Sea could be enhanced with additional funding and manpower. Priorities for the collection of input data have been identified previously (NAMMCO 2000, 2001) but it cannot be expected that these data gaps can be filled within a short time frame, even if new resources are dedicated to the activity. If new resources are not available, the required input data cannot be collected and it will not be possible to provide the advice to the Council.

One member, however, pointed out that even if required data should be collected, Minimum Realistic Models might not be able to realistically project the effects of an increased or decreased harvest of marine mammals. He argued that to firmly analyse the ecological effects of changes in the harvest of marine mammals a detailed understanding of the predator prey and competitive interactions of all relevant species is needed including a description of the density and prey dependent changes in the consumption functions of all species. While models that include all these interactions may, in principle, be able to predict the ecological impact of changed harvest levels, they represent unrealistic modelling approaches because it will be essentially impossible to estimate all the parameters. For most cases, he therefore found that it is unwise to base management on the predictions of multi species models, although he agreed that these models are needed for a more basic scientific level in order to obtain a better understanding of various ecosystems.

While there was some disagreement as to the suitability of minimum realistic models in general for providing management advice, it was agreed that this type of model was superior to the available alternatives. The Scientific Committee will assess any future modelling efforts critically with regard to the quality of input data, modelling assumptions and realism before deciding if any advice can be given.

The Scientific Committee agreed that the next meeting of the Working Group should focus on assessing modelling results from the Scenario Barents Sea model and possibly the GADGET-based template models for other areas, if they are developed. The Working Group should also consider the feasibility of connecting the multi-species models with simple economic models at that time. Walløe agreed to provide the Scientific Committee with a report on progress in the modelling efforts identified by the Working Group at next year's meeting. The Scientific Committee will assess progress made in modelling and in the collection of input data and decide at that time whether enough progress has been made to warrant another meeting of the Working Group.

Discussion by the Council

The Council reiterated the importance of multi-species management in general and the assessment of the interactions between marine mammals and fisheries in particular. The Council noted the conclusion of the Scientific Committee that progress in the development of multi-species models was unexpectedly slow, and agreed to forward this to the Management Committee for further consideration.

3.1.3 Harp and hooded seals

An aerial survey for harp seals in the Greenland Sea was carried out during the period 14 March to 6 April 2002. The last survey was carried out in 1991. The results from the aerial surveys will be used to estimate the total 2002 harp seal pup production. Subsequently, the status of the stock will be assessed by fitting population models to the pup production estimate. The ICES Working Group on Harp and Hooded Seals will meet in September 2003 to review these results and provide advice on stock management.

3.1.4 Narwhal

The Council has recommended that the Scientific Committee should concentrate its assessment efforts on the West Greenland narwhal in the near term, and that this assessment should be done jointly with the JCNB if possible. The Scientific Committee was informed about recent progress in satellite tagging and abundance surveys of narwhal in Greenland and Arctic Canada. A future assessment of narwhals in West Greenland may require two consecutive meetings to answer specific questions and to set scenarios for runs of population models. The Scientific Committee considered it advisable to hold the first assessment meeting in 2004, when surveys from several areas will have been completed and analysed. A subsequent meeting, probably in 2005, could deal with both narwhal and the new survey data for beluga which should be available at that time. Planning for future assessments will have to be done in conjunction with the Scientific Working Group of the JCNB.

3.1.5 Beluga

Some new results from satellite tracking of beluga have become available since the Scientific Committee last performed an assessment in 2001, but the information does not provide a basis for altering the present advice. The next survey of beluga on the wintering ground in West Greenland is planned to be conducted in March 2004. Results from this survey will – assuming successful completion – be available for revising the present advice in the autumn of 2004 or in 2005.

The Scientific Committee noted with satisfaction the progress in implementing a quota system for beluga and narwhal in Greenland, but further noted that recent harvest figures for Greenland indicate that little or no reduction in catch has taken place. The Committee has advised on 2 occasions (2000 and 2001) that the stock is substantially depleted and that present harvests are several times the sustainable yield, and that harvests must be substantially reduced if the stock is to recover. The Committee stressed that the apparent delay in reducing the catch to about 100 animals per year will result in further population decline and will further delay the recovery of this stock.

The Council agreed that the Management Committee would consider this matter.

3.1.6 Harbour porpoise

Feasibility studies into assessing the abundance of harbour porpoise in Norwegian inshore waters have been undertaken in 2000 and 2001. This involves combined line/strip transect cruises in nearshore waters. Analyses of the data are presently

underway.

An international small cetacean survey (following SCANS) as been scheduled for 2004 or 2005, and that the Faroe Islands and Norway plan to participate.

3.1.7 Fin whales

In 2002 the Council clarified its previous request for advice on fin whales, asking that the Scientific Committee continue with its assessments of fin whale stocks in the areas of interest to NAMMCO member countries with existing and new information on abundance and stock delineation as it becomes available.

An estimate of the abundance of fin whales from the NASS-2001 survey has been completed. The Committee noted that abundance estimates from the Norwegian survey area of the NASS-1995 survey have not been published, and estimates from subsequent surveys in the Norwegian area have not yet been produced. The Committee recommended that these estimates be completed on a timely basis.

Efforts to tag fin whales with satellite-linked tags have continued in the Faroes, Greenland and Iceland. In the Faroes, 12 tag deployments have been made in the past 2 years, of which 2 have transmitted data. One of these animals moved into the waters west of Bay of Biscay. Collection of tissue samples for genetic analysis has continued in the Faroes, Greenland, and Norway. In the Faroes and Norway, samples are collected through a biopsy program, while in Greenland samples are taken from the annual catch. Iceland has a large collection of tissue samples from historical catches, however virtually all of these are from western Iceland. The Committee noted that satellite tagging had indicated an apparent connection between fin whales in Faroes and in the waters near Spain and urged the addition of tissue samples from fin whales in these waters to ongoing studies on stock structure of North Atlantic fin whales.

The Scientific Committee noted that the success rate of deploying satellite tags on fin whales and other large whales was low and variable between research teams. There are several research groups working on large whale tagging in NAMMCO member countries, the USA, Japan and other countries, and the field is quite competitive. The Committee decided to establish an intersessional correspondence group to:

- identify progress in satellite tagging made in NAMMCO member countries and elsewhere;
- explore the technical aspects of satellite tagging, including deployment systems;
- briefly consider what tagging experiments have been done and the rates of success;
- recommend ways to further the development and success of this technique in NAMMCO member countries.

The Committee will report their findings at next years meeting of the Scientific Committee.

The Scientific Committee considered that the new abundance data for the Faroese and Icelandic areas could allow the assessments for these areas to be updated in the

coming year. An assessment of fin whales in the Norwegian area could be attempted if abundance estimates for the area are completed. Consideration should be given to contracting an update of the genetic analysis including new samples from the Faroes.

The Council recommended that the assessment be completed on a timely basis. In response to a question from Norway, Iceland confirmed that it would be requesting the IWC to conduct an assessment of fin whales, but did not expect this to be completed for 3 to 5 years.

3.1.8 Minke whales

In 2002 the Council recommended that the Scientific Committee should complete an assessment of Central Atlantic minke whales once new abundance estimates from NASS-2001 become available.

Estimation of abundance from the 2001 aerial survey and a reanalysis of the 1987 aerial survey data are presently being conducted under contract. Analysis of the ship survey data from 2001 is in progress. Analysis of the 1996-2001 series of Norwegian sightings surveys, which includes part of the Central Atlantic stock, has been completed and reported to the IWC. An aerial digital photographic survey of minke whales and other species is being conducted in 2002 in West Greenlandic waters, and will be repeated in 2003. Satellite tags have been deployed on 2 minke whales this year in Icelandic waters. Genetic analyses of the large number of samples from the Norwegian catch are ongoing. However more samples from surrounding areas, including the Faroes and Iceland, are required to refine the analysis. The Scientific Committee recommended that tissue samples be collected from these areas by biopsy or other means.

The Scientific Committee considered that a new assessment of the Central Atlantic stock could be conducted after the Working Group on Abundance Estimates has considered the new estimates from the Icelandic aerial survey and the Icelandic and Faroese ship surveys from NASS-2001.

3.1.9 White-beaked, white-sided dolphins and bottlenose dolphins

An abundance estimate for primarily white-beaked dolphins from the NASS-2001 Icelandic aerial survey has been produced, and estimates from previous aerial surveys are in progress. Estimates from the ship surveys have not been developed. Sampling programs from Icelandic bycatch of whitebeaked and the Faroese drive hunt whitesided and bottlenose dolphins have been conducted, and reports on life history and general ecology should be produced in the coming year. Norway will be initiating a sampling program involving the collection of approximately 60 whitebeaked dolphins for life history, genetic and feeding analyses. In addition biopsy samples are collected during sightings surveys.

At this point the Scientific Committee considered that there was still insufficient information on abundance, stock relationships, life history and feeding ecology to go forward with the requested assessments for these species. This may become feasible once further abundance estimates from the Icelandic and Faroese areas are produced,

and the ecological studies in the Faroes, Iceland and Norway are completed. The Scientific Committee recommended that these studies be completed in a timely manner. The Council endorsed this recommendation.

3.1.10 Grey seals

In 2002 the Council requested that the Scientific Committee provide a new assessment of grey seal stocks throughout the North Atlantic. Dr. Kjell Nilssen has accepted the position of chairman of the new Grey Seal Working Group. The general terms of reference of this Working Group will be:

- to assess the status of grey seals around Iceland, the UK, the Faroes, Norway, the Russian Federation, the Baltic, Canada and other areas;
- survey methods;
- stock delineation (genetics, temporal and geographical distribution);
- recommendations.

It was decided that the meeting should be held in early April in Iceland.

3.1.11 Humpback whales

In 2002 the Council recommended that the Scientific Committee complete abundance estimates for this species as a high priority, and should also consider the results of the "Years of the North Atlantic Humpback" (YoNAH) project as it pertains to member countries in providing advice for this species.

The Scientific Committee noted that abundance estimates are being completed for this species as a high priority. New abundance estimates from the NASS-2001 aerial and ship surveys are presently under development and there is evidence from the Icelandic aerial surveys that the stock is increasing at a rapid rate in that area. There has also been an increase in both incidental and survey sightings around the Faroes. The aerial digital photographic survey being conducted in West Greenland should provide an estimate of abundance in that area. Efforts to obtain photographs and biopsy samples from eastern Icelandic waters were continuing, as had been recommended last year. In Greenland, 4 satellite tags have been successfully deployed on humpback whales this year.

Information from the YoNAH project, pertaining to stock delineation, migration, biological parameters, and abundance both North Atlantic-wide and in feeding areas has been published. The Scientific Committee has noted previously (2001) that estimates from the NASS-95 survey appear to conflict with the results of the YoNAH project, and comparison with the estimates from NASS-2001 should be of great interest.

3.1.12 North Atlantic Sightings Surveys

NASS-2001

Minke whales

Analysis of data from the Faroese and Icelandic ship surveys is presently in progress. A preliminary estimate from the aerial survey around Iceland has been completed, and the final analysis is being conducted by a contractor. An analysis of trends in distribution and abundance of minke whales from aerial surveys conducted in the

coastal waters of Iceland in 1986, 1987, 1995 and 2001 showed that the distribution of minke whales was very stable from year to year, with highest densities in the SW, N and SE waters of Iceland. Relative abundance showed a significant increase in the area to the N of Iceland, and moderate but non-significant increases in the high-density area in SW Iceland (Faxaflói), NW Iceland and in the survey area as a whole, over the period. The Scientific Committee concluded that the abundance of minke whales around Iceland has been stable or shown a moderate increase over the period, and that the apparent increase in relative abundance in the area to the N of Iceland is consistent with population growth after cessation of catching.

Fin whales

An abundance estimate of 25,352 (95% CI 19,579 to 32,831) from the ship survey around Iceland and the Faroe Islands was accepted by the Scientific Committee. This is higher and more precise than estimates from equivalent areas from past NASS surveys. While some of this increase may be related to increases in survey efficiency, this factor alone likely cannot explain the observed increase since 1987. Stock increase, immigration from other areas, and/or variation in distribution between years may also be involved. The four NASS ship surveys carried out since 1987 provide an excellent time series of abundance for this species. It was therefore recommended that a more complete analysis of changes in abundance over all the NASS surveys be conducted. This may require some re-analysis of past survey data as the coverage has changed between surveys.

Humpback whales

A preliminary line transect estimate for humpback whales from the 2001 Icelandic aerial survey has been completed, resulting in and estimate of 3,057 (95% CI 1,727 - 5,410) for the area. However this estimate has a negative bias because of animals missed by the observers and, probably more importantly, animals missed because they were diving when the plane passed.

Sightings from the NASS-2001 ship survey were highly clustered around NE and W Iceland within the aerial survey block, but substantial numbers were also seen in areas farther offshore. More sightings were made in the Faroese block than in previous surveys. A contractor is presently conducting an analysis of these data and of data from the 1995 survey.

An analysis of the trend in sighting rate over the course of the 4 Icelandic aerial surveys carried out since 1986 showed an increase of 11.4% (SE 2.1%) per year over the period in the survey area. This rate of increase is in accordance with that of 11.6% over the period 1970 - 1988 in recorded sightings of humpback whales by whalers operating west of Iceland. There has been almost no catch of humpback whales around Iceland since the first stage of Icelandic whaling came to an end in 1915. Therefore, stock recovery is one plausible explanation for the trend, however the observed rate is on the edge of biological plausibility. Immigration from other areas may also be playing a role.

Lagenorhynchus dolphins
A preliminary abundance estimate for the Icelandic aerial survey has been completed, resulting in an estimate of 20,444 (95% CI 12,714 - 32,874). This estimate is biased downwards both by animals missed by observers and animals that were underwater when the plane passed over.

Analysis of the ship survey data from 2001 and earlier surveys is considered problematic because of uncertain species identification, uncertain group size estimation, and possible responsive movement of these species.

Sperm whales
A calculation of sperm whale abundance from the 2001 Icelandic and Faroese shipboard surveys, using a combination of cue-counting and line transect methodologies, resulted in an estimate of 11,185 (CV 0.34) for the area. However this estimate is heavily dependent on estimates of the proportion of the time the whales spend at the surface, and the frequency of deep dives, for which there is no data for the survey area. Once these data are collected, probably through radio-tagging studies, the estimate can be revised.

Other species
The Scientific Committee considered that, in addition to the species already mentioned, abundance estimates from the ship survey were feasible for pilot whales and bottlenose whales. These analyses should be completed in the coming year. For other species, such as killer whales and blue whales, the data are not suitable for the estimation of abundance, but general descriptions of distribution will be produced.

Evaluation of survey methodologies
The Working Group provided a detailed evaluation of the methodologies used in the ship and aerial surveys, and a list of recommendations for improvements. The Scientific Committee considered that the Report and the contributory working papers should serve as an excellent guide for the planning and conduct of future NASS surveys.

Future work
The Scientific Committee agreed that completion of the following analyses should be of high priority:

i. Aerial survey estimate of minke whales around Iceland from 2001 and 1987, accounting for bias due to measurement error and whales missed by observers. This work is presently being pursued under contract.
ii. Spatial analysis of humpback whale distribution and abundance, from 2001 and 1995 ship and aerial surveys. This work is presently being pursued under contract.
iii. Abundance estimate of minke whales from Faroese and Icelandic ship surveys, 2001. This is in progress;
iv. Abundance estimates for dolphins from the 2001 and earlier surveys;
v. Abundance estimates for pilot whales and northern bottlenose whales from the 2001 survey.

It was anticipated that all or most of this work could be completed in time for a meeting of the Working Group early in 2003.

Status for analyses and publications from previous NASS

Although the idea of publishing a volume on the North Atlantic Sightings Surveys (NASS) was dropped in 2000 by the Scientific Committee, it was revived in 2001 following the completion of NASS-2001. The Scientific Committee agreed that a special volume on the NASS surveys in general would be of great interest to many researchers. Four NASS surveys have been conducted, over a long enough time frame that temporal trends in distribution and abundance may be detectable. The volume therefore should not merely report abundance estimates from the later surveys, but should synthesise results from all the NASS surveys to elucidate temporal and spatial patterns. It was considered that the volume could best be organised by species, with contributors using information from all the NASS surveys regardless of national affiliation.

It was agree that Dr Nils Øien and Daniel Pike would edit the new volume. Given the amount of work that remains to be done, this volume will not be completed before sometime in 2004. The Council endorsed the idea of a new volume of *NAMMCO Scientific Publications* on the NASS.

3.1.13 NAMMCO science fund

At the 9th meeting of the NAMMCO Council in 1999, the Chairman of the Scientific Committee, Dr Mads Peter Heide-Jørgensen, proposed that the Scientific Committee be given the option of conducting its own research with funding provided by the Council. Subsequently the Scientific Committee developed a full proposal for such a Science Fund, with examples of projects that would address issues put to it by Council, and could be supported within the proposed funding level of the Science Fund. The proposal for the Science Fund, along with these examples of projects that could be conducted under the program, was presented to the Council at their 11th meeting in February 2002. The Council decided not to support the establishment of a NAMMCO Science Fund. The Council did however acknowledge that a better way must be found to convey the priorities of the NAMMCO to National Research Institutions.

The Scientific Committee expressed its disappointment that a Science Fund could not be established. As the intention of the Fund was to fund research that would facilitate and accelerate the response of the Scientific Committee to requests put to it by the Council, the Committee noted that its recommendations for research must be acted upon by national research institutes if the requests of the Council are to be fulfilled in a timely manner.

In discussion the Council agreed that a better way must be found to communicate the research priorities and recommendations of the NAMMCO to member countries. In addition, the Council needed a way to determine if these recommendations were being implemented. One suggestion was to do this through the National Progress Reports.

The Council instructed the Secretariat to provide the next meeting with recommendations for achieving these goals.

3.1.14 Publications

Four volumes of NAMMCO Scientific Publications have now been published: Vol. 1 *Ringed seals in the North Atlantic*, Vol 2 *Minke whales, harp and hooded seals: Major predators in the North Atlantic ecosystem*, Vol. 3 *Sealworms in the North Atlantic: Ecology and population dynamics*, and Vol. 4 *Belugas in the North Atlantic and the Russian Arctic***.** The latter was published late in 2002 and has been distributed to libraries, research institutions and to journals for review.

Volume 5 with the working title *Harbour porpoises in the North Atlantic*, ed. Haug, T., Desportes, G., Víkingsson, G. and Witting, L., should be out in 2003. In addition the Scientific Committee has decided to proceed with a volume on the North Atlantic Sightings Surveys (see above).

3.1.15 Future work plans

It was decided that Greenland would host the next meeting of the Scientific Committee in November 2003, at a location yet to be determined.

At least 4 working groups are expected to be active in 2003: Grey Seals, Abundance Estimates, North Atlantic Fin Whales and North Atlantic Minke Whales. In addition two new groups will meet by correspondence: Satellite Tagging and Advice Requests. Given the number of meetings and the fact that some contract work will be necessary to support these activities, costs might exceed the usual budget allocation of the Scientific Committee.

3.1.16 Election of officers

Gísli Víkingsson was elected as chairman for an additional year, and Lars Walløe was elected as vice chairman.

3.1.17 Other matters

The Chair of the Council thanked the Scientific Committee Chair for a comprehensive report, and noted the importance of the work of the Scientific Committee to NAMMCO.

International Convention on Migratory Species

During the meeting the Scientific Committee learned that the International Convention on Migratory Species (CMS), the Bonn Convention, was considering the listing of a number of species of whales as being threatened with extinction or having an unfavourable conservation status. Once listed, member countries will be obligated to take management actions that may preclude harvest in some circumstances. The main reason for the listing action would appear to be that some of these species are also listed in the IUCN "Red List".

The Scientific Committee expressed concern about this matter and noted that many Red List classifications were themselves outdated and based on questionable

information. The Scientific Committee therefore advised the NAMMCO Council and the member governments to initiate a scientific review and revision of the "Red List", so that new and more accurate status can be assigned to each of the North Atlantic marine mammals species.

Provision of advice on sustainable catch to the Council

The Scientific Committee considered ways in which it could improve and enhance the provision of its advice on sustainable catches to the Council. A review of requests for advice from the Council showed that they have varied quite widely, ranging from general requests for stock assessments, to requests mentioning specific potential catch levels. It was apparent that more specific and detailed requests for advice from the Council resulted in more useful advice from the Scientific Committee. The Scientific Committee agreed that the explicit statement of management goals was one of the most important considerations in providing high quality scientific advice on sustainable catch. Requests for advice on catch levels should contain a minimum of information about management goals and timelines so that they can be responded to effectively. It was agreed that a Correspondence Group should be established to provide guidance to the Council in the most effective formulation of requests for advice, and report back to the Committee in advance of the next meeting of the Council. The Scientific Committee accepted the Report of the Correspondence Group in February 2003.

There are two major components that influence the provision of advice on sustainable catches: the desired management objectives and the uncertainty in our understanding of the biological system. In general, the management objectives should be given politically and they should define the desired concept of sustainability. The biological uncertainty and the catches can then determine the degree to which these objectives can be met.

While considering desired objectives and the corresponding uncertainty, the Scientific Committee favoured a management approach where the uncertainty is calculated into the probabilities by which the desired management objective will be achieved for different catch levels. If, as envisioned by the Scientific Committee, a desired probability of meeting the objective is determined politically, it follows that the catches will be set by the trade-off between the political objectives and the biological uncertainty. The advice provided for the West Greenland beluga is one example of this, where different catch scenarios resulted in different probabilities of halting the decline in the stock. The advantage of this approach is that it enforces not only a definition of a desired objective but also a definition of the risks that the managers are willing to take. This, however, may not always be achievable, and management advice may instead have to be based on less certain knowledge, *e.g.* stock projections calculated from a most likely scenario and a few other plausible scenarios to get an impression of the sensitivity of the projections.

In order to obtain the best possible advice from the SC, a request from the Council should preferably be associated with

- A definition of the group of animals. Either in the form of a geographical area or by the catch area or landing positions with operational restrictions. In these cases the SC will aim to define an appropriate management unit. Alternatively an explicitly defined management unit may be given, in particular if such a unit has already been defined.
- A definition of the desired management objectives. An increasing, decreasing, or stable stock, and if there is a specific target abundance.
- If required, a length of time over which the objective should be achieved. This may apply mainly to a specified abundance level, but also to stopping a population decline or to achieving a stable stock size.

An alternative scenario, that has not been discussed here, is where the Scientific Committee is asked to investigate the effects of some desired catches. Provided that the management unit is well defined and there are sufficient data, such effects may also be estimated.

The Council appreciated the efforts of the Scientific Committee in improving their advice. The Council agreed to frame future requests for advice along the lines suggested, and to revisit outstanding requests if necessary.

4. MANAGEMENT COMMITTEE

4.1 Report of the Management Committee

The Chairman of the Management Committee, Kaj P. Mortensen (Faroe Islands) reported to the Council on the meeting of the Management Committee, held in Asker, 5-6 March 2003. A preliminary report was distributed as NAMMCO/12/7-Draft, containing the substantive issues agreed to by the Management Committee. (The final edited version of the report was adopted by correspondence after the meeting. See Section 2.1).

4.1.1 National Progress Reports

The Council noted the Management Committee's appreciation to the member countries for the National Progress Reports for 2001. The Council further noted that Canada and the Russian Federation had not responded to the invitation to present progress reports to the 10th meeting of the NAMMCO Scientific Committee. The Council noted that the Secretariat would forward separate invitations to Canada and the Russian Federation to present such data to NAMMCO.

The Council noted that the Observer for Canada had presented information on a multi-year management plan for the Atlantic seal hunt, announced by the Canadian government in February 2003. The Council noted that the new management measures had not been discussed bilaterally between Greenland and Canada, which was unsatisfactory to Greenland. The Observer from Canada was asked to convey this message to the Canadian Government.

The Council noted that Norway urged member countries to systematically collect samples from minke whales for improved stock delineation.

4.1.2 Proposals for Conservation and Management

Status of past proposals

Atlantic walrus

The Council noted that comprehensive public hearings had been in Greenland on the draft regulations for this species, that these had been submitted for comment to the Council of Hunters, and that a final decision on the initiative was expected later this year.

Ringed seals

The Council noted that Greenland is instituting a regulatory system for ringed seals whereby quotas could be introduced if required, but that such quotas are not considered necessary at this time. The Council also noted the updated information on the increased incidence of hairless and partially hairless seals in Greenlandic waters and that the Management Committee urged further research into the origin of this phenomenon (see Section 2.1, item 5.2, page 116).

Harp and hooded seals

Northwest Atlantic

The Council noted the Management Committee's comment that if the full quotas are taken in the new 3-year management plan for Atlantic harp seals of Canada the total harvest by Greenland and Canada will exceed the replacement yield and would result in a stock decline over this period. Nevertheless it would not pose any threat to this stock because of its recent rapid growth and very high current abundance.

The Council noted Canada's information that the recent harvest of the hooded seal stocks had been in the low hundreds.

White/Barents Sea and Greenland Sea

The Council noted that the Scientific Committee would review new information later this year on harp seals abundance, movements and genetics considered by the ICES/NAFO Working Group.

Northern bottlenose whales

The Council noted that the Scientific Committee next year would consider the new abundance estimates from NASS 1995 and 2001. It was further noted that 6 bottlenose whales had stranded and had been utilised in the Faroe Islands in 2002.

Long-finned pilot whales

The Council noted that the Scientific Committee next year would consider a new abundance estimate from NASS 2001. The Council noted that the Faroese effort to tag pilot whales with satellite-linked radio-transmitters would continue.

Minke whales – Central North Atlantic

The Council noted that the Scientific Committee would undertake new assessments of this stock in 2003 on the basis of NASS-2001 and a revised estimate from 1987, and that the Management Committee considered this to be of high priority.

Beluga West Greenland
The Council noted that comprehensive public hearings had been held in Greenland on the planned quotas to drastically reduce the harvesting and on the draft hunting regulations. It was noted that the introduction of quotas had been delayed, but that the Council of Hunters had received the draft regulations for their consideration. The Council noted the Management Committee comment that the response by Greenland in this matter would have ramifications for the credibility of NAMMCO as an organisation.

Narwhal West Greenland
The Council noted that a joint assessment meeting between the NAMMCO Scientific Committee and the Scientific Working Group of the Canada/Greenland Joint Commission on Narwhal and Beluga (JCNB) is scheduled for 2004 to consider new information on abundance. It was further noted that the regulatory initiative of Greenland for beluga and walrus would also apply to narwhal.

Fin whales – East Greenland – Iceland stock area
The Council noted that new assessments of this stock was planned for 2003 on the basis of NASS-2001 and recent Norwegian surveys, and that the Management Committee concluded that this should have high priority for the Scientific Committee. It was also noted that the Management Committee emphasised the importance of continuing the assessment efforts of all relevant species in NAMMCO (See Section 2.1, item 5.10, page 117).

Incorporation of User Knowledge in the Deliberations of the Scientific Committee
The Council noted that the Management Committee, on the basis of the report from the recent Conference on User Knowledge and Scientific Knowledge in Management Decision Making (see Section 1.3) had agreed to form a Working Group dealing with the issues noted in the recommendations and conclusions from the Conference (See Section 2.1, item 5.11, page 118). It further noted that one of the tasks of the Working Group would be to re-visit the existing proposal by the Scientific Committee (see NAMMCO Annual Report 1999), and recommend if it should proceed or be modified in light of the recommendations from the Conference.

Status of Past Requests
The Council noted the document NAMMCO/12/MC/4, an updated summary of requests for advice by the NAMMCO Council to the Scientific Committee, and responses by the Scientific Committee since 1992.

The Council further noted that Scientific Committee reiterated its conclusion that little progress can be expected on research into multi-species management and marine mammal- fishery interactions unless significant new resources are allocated for multispecies modelling and for collecting data on marine mammal diet and consumption.

4.1.3 Report of the Working Group on By-catch
The Council noted that the National Progress Report format had been further modified

to incorporate the reporting of bycatch to NAMMCO, but that reporting and use of the new format from some countries was still inadequate. The Council noted the Management Committee's endorsement of the recommendations that the member countries are encouraged to report their bycatch to NAMMCO through the new National Progress Reports format. Furthermore, the Working Group would fully evaluate a functioning bycatch monitoring system as soon as one of the member countries has a functioning system in place. It was noted that based on this evaluation the Working Group would make recommendations on by-catch monitoring to all member countries (Section 2.1, item 8, page 121).

The Council noted that the Management Committee would require the Scientific Committee to evaluate the accuracy and precision of bycatch data in their assessment of any stocks subject to bycatch.

4.2 Recommendations for Requests for Advice

4.2.1 Economic Aspects of marine mammal – fisheries interactions

New Request for Advice

The Council agreed to the Management Committee's recommendation that the Scientific Committee should monitor progress made in multi-species modelling and in the collection of input data. The Council also noted that particular focus should be given to the development of Scenario Barents Sea model, the GADGET-based template models, and on the feasibility of connecting the multi-species models with simple economic models (Section 2.1, item 7.1.1, page 119).

Recommendation for Scientific Research

The Council noted the Management Committee's reiteration of the recommendation for research on consumption by marine mammals (NAMMCO Annual report 2002). The Council noted the list of research items emphasised by the Management Committee to be given high priority by National Governments (Section 2.1, item 7.1.2, page 119).

4.2.2 Harp and Hooded Seals

New Request for Advice

The Council noted the reiteration by the Management Committee that the Scientific Committee regularly update the stock status of North Atlantic harp and hooded seal stocks as new information becomes available, and that new information on abundance is available. The Council noted that the immediate management objective for harp seals and the Northwest Atlantic is to maintain stocks at their present level of abundance.

4.2.3 Beluga West Greenland

New request for advice

The Council noted that the Management Committee requested the Scientific Committee to update the assessment of West Greenland beluga based on results from the upcoming 2004 survey. The Council noted that the main management objective is to halt the decline of this stock.

4.2.4 Fin whales

The Council endorsed the Management Committee's emphasis that the scheduled assessments for the East Greenland-Iceland and Northeast Atlantic stocks should proceed as a high priority for the Scientific Committee. The Council also noted the Management Committee's support for the efforts of the Scientific Committee to assess the technical aspects of satellite tagging of large whales.

4.2.5 White-beaked, white-sided and bottlenose dolphins

The Council endorsed the Management Committee's continued emphasis on the importance of continued assessment efforts of these species. It was further noted that new information on abundance, diet, life history and stock delineation is becoming available from the NASS –2001 survey, and from sampling programs in the Faroe Islands and Iceland in addition to a new programme being initiated in Norway.

4.2.6 North Atlantic Sightings Surveys

Recommendations for scientific research

The Council agreed to the Management Committee's recommendation that member countries continue to co-ordinate cetacean surveys across the North Atlantic, and attempt to broaden the coverage of these surveys through inclusion of other participants. The Council noted the Management Committee consideration that the information on abundance and distribution provided by the series of NASS is crucially important in the management of stocks throughout the North Atlantic.

4.2.7 Others

Minke Whales

The Council noted that the assessment of Central Atlantic minke whales, based on the NASS-2001 abundance estimates would be carried out in 2003.

4.2.8 Grey Seals

The Council noted that the Scientific Committee would conduct the assessment of grey seal populations as recommended in 2002 this year (see NAMMCO Annual 2001)

4.2.9 Humpback Whales

The Council endorsed the Management Committee's reiteration of its request from last year that the completion of the abundance estimates of this species should have high priority. It was further noted that the Scientific Committee would consider new abundance estimates from the NASS-1995 and 2001 within the coming year.

4.3 International Observation Scheme

The Council noted the Management Committee review of the implementation of the Observation Scheme for 2002 under the Joint NAMMCO Control Scheme for the Hunting of Marine Mammals, and for the planned observation activities for 2003 (see Section 2.1).

The Council endorsed the Management Committee's encouragement for further expansion of on-board observations lasting more than one day.

4.3.1 Report of the Committee on Inspection and Observation

The Council noted the Management Committee's decision not to recommend an increase in the budget for the Scheme at this time. The Council noted the Management Committee's endorsement that observations should focus on particular hunting activities and/or regions in some years. The Council endorsed the Management Committee support of the recommendation that the member countries nominate more than one observer-candidate to facilitate the implementation of the Scheme. The report from the Committee is contained in Section 2.3.

4.4 Other Business

The Council acknowledged that in addition to the ongoing work by the Scientific Committee on marine mammal – fisheries interaction, there is a need for a broad-based approach to consider changes in management systems that might be required when using multispecies, ecosystem-based approaches to management as considered by the Management Committee.

The Council endorsed the Management Committee's decision to establish a Working Group on Enhancing Ecosystem-based Management (Section 2.1, item 11.1, page 123).

5. HUNTING METHODS

5.1 Report of the Committee on Hunting Methods

The Chairman of the Committee on Hunting Methods, Jústines Olsen (Faroe Islands) presented the report of the Committee to the Council. The Committee met in Copenhagen 31 January 2003. The report is contained in Section 1.2.

The Council noted the updated information on developments in hunting methods in the Faroe Islands, Greenland and Norway, which had been presented to the Committee during the January meeting (Section 1.2, page 63).

The Committee Chairman presented the updated lists of regulations and references on hunting methods in the member countries (Section 1.2, Appendices 1 and 2).

The Chairman of the Committee presented the status of each country's follow-up on the recommendations resulting from the NAMMCO Workshop on Hunting Methods (Greenland February 1999), which had been adopted by the Council at its 9th Annual Meeting (Akureyri, Iceland 1999). See NAMMCO Annual Report 1999, Section 1.3, item 7 page 71. Follow-up to the recommendations were also reported to the NAMMCO Council at the 10th Annual Meeting in Sandefjord, Norway 2000 (see NAMMCO Annual Report 2000, Section 1.2, item 4, page 61), and 11th Annual Meeting in Ilulissat, Greenland 2002 (NAMMCO Annual Report 2001, Section 1.2, item 3, page 62).

The Chairman presented an update on the recommendations resulting from the NAMMCO Workshop Marine Mammals: Weapons, Ammunition and Ballistics in Sandefjord, Norway in 2001 (see NAMMCO Annual Report 2001, Section 1.3, page 71). These recommendation were endorsed by the NAMMCO Council at their 11th meeting in Ilulissat Greenland in 2002 (see NAMMCO Annual Report 2001, Item 5.1.1 page 27).

The Council noted the decisions made by the Committee with respect to the recommendations 1) and 2). 1) The set of draft guidelines for methods used to undertake more controlled and standardised studies of the effect of different weapons and ammunition on different species would be presented to the Council at their next meeting in March 2004. 2) The harmonisation of weapons and ammunition would start with seals, and would be a topic at the planned Workshop on seal hunting methods (Section 1.2, page 65 and also next recommendation).

The Council endorsed the Committee's recommendation to hold a Workshop on Seal Hunting Methods in September 2004, in Tromsø (Section 1.2, page 65). The Council further endorsed the Draft Terms of Reference for the Workshop:

- to review existing seal hunting methods known
- to evaluate methods used in seal hunting in relation to killing efficiency and struck and loss rates
- to examine possibilities for technical innovation and further enhancement of efficiency and safety of hunting methods, with a view to providing recommendations for improvement where relevant, and
- if possible, determine minimum requirements for safe and efficient killing of different seal species, considering variations in hunting methods.

The Council agreed that the Committee should proceed with its plans for the Workshop and provide a draft budget for the Finance and Administration Committee.

5.2 Other business

The Council took note of the information provided by Dr Egil Ole Øen regarding the IWC Workshop on Whale Killing Methods and Associated Welfare Issues to be held in conjunction with IWC 55 in Berlin this year.

6. THE NAMMCO FUND

6.1 Report of the NAMMCO Fund

The Chairman of the Board of the NAMMCO Fund, Kaj P. Mortensen (Faroe Islands), presented the report of the Board to the Council. The Board had two meetings in 2002, one in Copenhagen on 4 September 2002, to review the 2001 applications for funding from the NAMMCO Fund, and a telephone meeting in December 2002 to discuss potential projects for the NAMMCO Fund. The report was contained in document NAMMCO/12/9.

The Council noted that the total available funds for 2002 were NOK 245,000 (the budgeted amount of NOK 200,000 and NOK 45,000 released after a previously funded project had been withdrawn).

6.1.1 Applications

The Council noted that the Secretariat had received six applications for funding for 2002, one of which had been rejected by the Secretariat because it did not meet the criteria for application. The Council noted that the Board of the Fund had decided to fund four proposals.

The successful applications were:
Seal hunting and the life of seal hunters in Northern Norway – An historical account of sealing, seal hunters and the life in the ice from the last 100 years, by Brit Johansen a Norwegian freelance historian. The book will focus on both the sealers and the vessels they used for sealing, and will be based on interviews with retired sealers, information from private collections and newspapers.

North Atlantic Marine Mammals: An interactive computer program – A computer programme created by an Icelandic team of freelance consultants. The objective of the programme is to spread knowledge on marine mammals through an accessible and easy to use design. It is a useful tool for primary and secondary schools, natural history museums, nature centres and tourist information centres. The program will teach the user how to recognise and classify the different species and about the role of marine mammals in the ecosystem.

Marine mammals in Northern Cultures – Publication of a book that is the end product of a joint Nordic research project led by at the University of Oslo, Norway, and published by the Canadian Circumpolar Institute. The book analyses the relationship between local perceptions of nature and resource management and the impacts of modern environmental and animal rights movements have on this relationship. The book is written with the general reader in mind, but will also be useful for students and resource managers.

Use of Marine Mammals in Greenland – Information for Tourists and Travellers – An information brochure and website, by Scanagri, Denmark A/S with the aim to provide balanced information to the international tourist sector on marine mammal management in Greenland. The information will facilitate further understanding of relevant international organisations in relation to tourist related export of handicraft made from marine mammal in Greenland.

6.1.2 Other business

The Council noted that one of the projects funded last year had been completed, two others was near ninety percent completed, and that one had been granted an extension.

The Council endorsed the revisions to the Fund Policy and Application Procedure. The Council agreed that the Board of the Fund could request applications on specific issues (see NAMMCO Annual report 2001 page 29) but agreed that information about NAMMCO should be produced by NAMMCO, and that the Secretariat could increase its efforts in providing relevant information to a general audience.

The Council noted that the Faroe Islands would submit a written proposal for restructuring the Fund prior to the next annual meeting.

The Council **agreed** to reallocate funds (NOK 100,000) from the NAMMCO Fund to the Information item in the budget for use in the production of relevant information about NAMMCO. The Council **agreed** that NOK 100,000 would be allocated for the NAMMCO Fund in the budget for 2003.

7. ENVIRONMENTAL QUESTIONS

The Council noted that letters had been sent to two ministers in the United Kingdom expressing NAMMCO's concern about the nuclear pollution from Sellafield as requested at NAMMCO/11. The letters were available to the meeting as document NAMMCO/12/13-1.

The Council noted that in an effort to establish formal relations with OSPAR the Secretariat had applied for formal Observer Status to the OSPAR Convention. The letter was available to the meeting as NAMMCO/12/13-2. The Faroe Islands welcomed the approach and expressed its hope for a speedy reply (see also under Item 9.1.1, page 39).

At NAMMCO/11 the Council instructed the Secretariat to investigate the status of the request for advice forwarded to ICES in the first few years of the establishment of NAMMCO.
1. ICES is requested to describe the possible pathways of radioactive material from blowouts and leakage in existing nuclear power plants, leakage from dumped material and possible accidents in planned re-cycle plants in the northern part of Scotland into the food-web of the North Atlantic and hence into the top predators like marine mammals.
2. ICES is requested to review the contaminant burden (especially organochlorides) in marine mammals in the North Atlantic and evaluate the possible sources of these contaminants.

In the reply from ICES the Secretariat received Section 12 of the Report of the Advisory Committee on the Marine Environment (ACME) from 1998. The Council noted that the reply from the ICES Secretariat and the ACME document do not address the request regarding radioactive material, nor do they evaluate the possible resources of contaminants in the North Atlantic. The Council took note of a letter from the General Secretary of ICES in which he informs NAMMCO that it is not clear what happened to the 1992 requests from NAMMCO, but ICES has not been involved in work concerning contaminants burden since 1998. The correspondence between NAMMCO and ICES was available to the meeting as NAMMCO/12/13-3.

The Council instructed the Secretariat to compile information on contaminants relevant to NAMMCO member countries from other sources such as AMAP 2002.

8. THE NAMMCO CONFERENCE ON USERS KNOWLEDGE AND SCIENTIFIC KNOWLEDGE IN MANAGEMENT DECISION MAKING

The Council reviewed the results from the NAMMCO Conference on *User Knowledge and Scientific Knowledge in Management Decision-Making* held in Reykjavik Iceland 4 – 6 March 2003. The report was available to the meeting as document NAMMCO/12/10, and is found in Section 1.3of this report. The Secretary reported on the Conference, which had been organised by the Secretariat. The Secretariat developed the programme for the Conference in co-operation with a Conference Advisory Committee with two representatives from each NAMMCO member country. The Conference was financed by NAMMCO, with generous support from the Nordic Council of Ministers, the Norwegian Ministry of Foreign Affairs, the Faroese Ministry of Fisheries and Indigenous Survival International, Greenland. Generous in-kind support was received from the Icelandic Ministry of Fisheries and the Institute of Marine Research, Iceland.

More than 120 participants from 11 countries attended the Conference, among them hunters, fishermen, scientists, resource managers and others.

The background for the Conference was the apparent differences of opinion between whalers, sealers and fishermen (users) on the one hand, and scientists on the other with respect to, for example, the actual numbers of animals found in an area, their migratory routes, feeding habits and biology. While marine mammal management has great impact on the resource-users, their knowledge about resources is not included in the same manner as science, in making management decisions. The goal of the Conference was to find ways to incorporate user knowledge into the management decision-making process in parallel with science.

The key topics for the Conference were:

- National and international aspects of resource management, and the structure of the decision-making process
- Existing projects that consider user knowledge in management
- How user knowledge and scientific knowledge is gathered, kept and transmitted.
- The strength and weaknesses of the two types of knowledge.
- An examination of the co-operation between scientists and users with respect to the utilisation of their knowledge, and
- The role and application of user knowledge and scientific knowledge in management decisions.

The Secretary drew attention to Appendices 1 and 3 of the report to the Council which included the programme for the Conference and summaries of the presentations and the discussions (Section 1.3). The Council noted that there were a number of common themes emerging from the presentations and discussions. These included:

- The need for early and formal involvement of users in both science and management
- The need for documenting the availability of user knowledge, its characteristics and how it works

- Continuity and accountability to build trust between the parties
- A need for a significant investment of time, effort and money to move the process forward
- All parties must show humility, and recognise their own fallibility and limitations, and
- A strong commitment to agreed-upon goals and objectives.

The Council noted that an *ad hoc* drafting group had been established at the beginning of the Conference to draft a set of recommendations that were presented to the participants at the end of the Conference (contained in Appendix 2, section 1.3). These recommendations were considered by the Council together with the conclusions from the Secretariat with suggestions on how to move the process forward. The Council agreed that the follow-up from the Conference would be two-pronged. Firstly a short-term follow-up would be to compile and publish the presentations from the Conference along with a review of other management systems that have involved user knowledge (or traditional knowledge) in the management decision-making process. The Council agreed that the Conference Advisory Group would serve as an editorial group for the publication of the Conference proceedings and the review. The Secretariat was instructed to maintain a list of literature references on the topic. Secondly a long-term follow-up would be to establish a Working Group under the Management Committee to continue moving the work forward. The general terms of reference for the Working Group would be based on the recommendations and conclusions as listed in the Report from the Conference (section 1.3). The Council agreed that the Conference had been a success and that it was important to continue to keep the topic on the NAMMCO agenda.

9. EXTERNAL RELATIONS

Under this item the Secretary informed the Council of the meetings officially attended by NAMMCO and reviewed relations with those organisations with which NAMMCO exchanges observers.

9.1 Co-operation with other international organisations

The Secretary drew attention to document NAMMCO/12/11.

IWC International Whaling Commission

The Council noted that the Secretary and Charlotte Winsnes, the Administrative Co-ordinator had represented NAMMCO as observer at the 54th Annual Meeting of the IWC, which was held in Shimonoseki, Japan in March 2002. The Scientific Secretary, Daniel Pike represented NAMMCO at the IWC Scientific Committee meeting in Shimonoseki. The Scientific Secretary presented a number of scientific papers to the IWC Scientific Committee. The references to the papers are contained in NAMMCO/12/11-2.

In following previous practice NAMMCO submitted an opening statement to the IWC Annual Meeting providing updated information on recent activities of the

organisation. The statement was available to the Council meeting as document NAMMCO/12/11-3.

The Secretary also reported that NAMMCO was given an opportunity to make an intervention under the IWC agenda item dealing with Whale Killing Methods. The statement was contained in NAMMCO/12/11-3, part 2.

Arctic Council – Senior Officials Meetings and Ministerial Meeting

The Secretary informed the Council the she had attended two Senior Arctic Officials meetings in Finland, and the Ministerial Meeting held in Inari, Finland. The Council noted that NAMMCO's Observer status to the Arctic Council was renewed at the Ministerial meeting in Inari, Finland 7 – 10 October 2002. The Council noted that the Ministerial meeting concluded with the signing of the Inari Declaration (available to the meeting as document NAMMCO/12/12-3).

The Secretary reviewed the NAMMCO activities in the Arctic Council, which included two specific projects. The Secretary is a contributing author to the chapter in the Arctic Climate Impact Assessment (ACIA) titled *Assessing Vulnerabilities: A Strategy for the Arctic. An Interdisciplinary and Intercultural Study to Assess the Vulnerabilities of Coupled Human-Environment Systems in the Arctic*. Further information was contained in document NAMMCO/12/12-4. The General Secretary is also a member of the Steering Committee for the Arctic Human Development Report (AHDR) under the Arctic Council. This Report is a high priority for the Icelandic chairmanship to the Arctic Council. Further information was available to the meeting in document NAMMCO/12/12-6.

The Council agreed that it would be necessary to streamline the efforts of NAMMCO in the Arctic Council, and decide which issues are of most interest to NAMMCO. The Council instructed the Secretary to produce a short report on the work of the Arctic Council and suggest a best effort strategy for NAMMCO in relation to the Arctic Council. In this regard it was noted that it is important that information about NAMMCO is distributed in international fora.

CITES – Convention on International Trade in Endangered Species

The NAMMCO Chair, Amalie Jessen (Greenland) represented NAMMCO at the CITES CoP 12, Santiago, Chile 3 – 15 November 2002. A statement from NAMMCO circulated to the meeting was contained in NAMMCO/12/11-11.

NEAFC – North East Atlantic Fisheries Commission

Ole-David Stenseth (Norway) represented NAMMCO at the 21st Annual Meeting of NEAFC, held in London 12 - 15 November 2002. A representative from Norway presented the report in Mr Stenseth's absence. The Commission had reviewed reports from the International Council for the Exploration of the Seas (ICES) concerning the status of fish stocks in the North-East Atlantic. Specific attention was given to reports on stocks under NEAFC's regulatory competence. NEAFC agreed on management measures to control the exploitation of major fish stocks in international waters, and to increase the efficiency of its Scheme of Control of Enforcement. NEAFC reviewed

recent trends in the international management of marine resources, including the ecosystem approach, cooperation with other regional and global organisations and other developments. The report from the NAMMCO observer was available to the meeting as NAMMCO/12/12-5.

NAFO – Northwest Atlantic Fisheries Organisation
Iceland represented NAMMCO at the 24th Annual Meeting of NAFO, held in Tórshavn, the Faroe Islands, 3- 7 June 2002.

NASCO – North Atlantic Salmon Commission
The Faroe Islands represented NAMMCO at the 20th Annual Meeting of NASCO, held in Santiago de Compostela, Spain 16 – 20 September 2002.

World Council of Whalers
The Secretary attended the fourth general assembly *Whaling for the Future* of the World Council of Whalers, held in Tórshavn 25 – 29 September 2003. The Council noted that the main topics for the meeting were whaling community viewpoints from around the world, human health issues and whale products, local, regional and global approaches to whale management, the economics of whaling in terms of trade and sustainable development and the future of whaling. The Council noted that the Secretary presented a paper about NAMMCO under the session on International Co-operation - Regional Approaches.

9.1.1 Other meetings and relation

OSPAR Convention
The Council noted the letter to OSPAR in which NAMMCO seeks formal Observer Status to the OSPAR Convention (see also item 7 page 35 in this volume). The Council **agreed** that it is important to have formal relations with this Convention, and that these relations could be strengthened through the NARFMO (North Atlantic Regional Fisheries Management Organisation) co-operation.

ICES – International Council for the Exploration of the Sea
The Secretary informed the Council of recent communication with ICES regarding a possible Memorandum of Understanding on a strictly scientific basis between NAMMCO and ICES. The Council instructed the Secretary to continue the communication with ICES and to report back to the Council on the costs involved in seeking scientific advice from ICES and review what scientific questions NAMMCO would be likely to ask.

Norwegian Small Whalers Association
The Council noted that the Secretary had attended the Annual Meeting of the Norwegian Small Whalers Association, in Svolvær, Norway 18 – 19 October 2002. It was further noted that the topics under consideration included principles of future management of minke whales, in terms of research, politics and trade.

10. INFORMATION

The Secretary informed the Council of the work and plans regarding information on NAMMCO that is aimed at the general public and of work that had been presented by the Secretariat members in different fora.

The Council agreed that the Secretariat would prioritise the production of information aimed at the general public, and that the website could be improved. The Council noted that due to time constraints at the Secretariat the planned website developments have not progressed satisfactorily, but that assistance would be sought from a professional web designer. (See Item 6.1.2 regarding transfer of Funds from the NAMMCO Fund to Information.)

The Council noted that the basic texts on NAMMCO, such as the NAMMCO Agreement and Rules of Procedure, would be compiled in a handbook for distribution to the member countries and other interested parties.

Greenland proposed that the most relevant NAMMCO documents would be translated into Greenlandic and made available from the Secretariat. Greenland would be responsible for the translation of the documents.

The Scientific Secretary attended the *2002 ICES Annual Science Conference and Centenary* held in Copenhagen 1 – 5 October 2002. A list of topics and relevant papers presented at the Conference was contained in NAMMCO/12/12-1.

The Council noted that the Secretary had published a feature article in the newspaper *Nordlys* outlining NAMMCO and the role of science in management. The article was available to the meeting as NAMMCO/12/12-5.

The observer from the EBCD (European Bureau on Conservation and Development) Ms Despina Symons informed the meeting about recent developments in the European Union (EU) with regard to membership in the IWC. She informed the meeting that the EU has no common position on whaling. The EU has launched a new study that will provide the input to a new initiative for protecting cetaceans.

The observer from the IWMC (International Wildlife Management Consortium) informed the Council of a new book on conservation issued by Mr Eugene Lapointe, the President of the IWMC.

The Faroe Islands informed the meeting of the second North Atlantic Conference 2003 to be held in Lerwick, Shetland 1 – 2 October. The Council noted that the North Atlantic Conference 2003 will highlight current views and approaches towards ensuring a clean and productive marine environment and sustainable use of its resources in the region. One of the main aims of the Conference is to strengthen co-ordination of regional approaches to marine environmental protection and the sustainable utilisation of marine resources in the North Atlantic, as well as enhancing co-operation between North Atlantic coastal nations and communities.

11. OTHER BUSINESS

There was no other business.

12. CLOSING ARRANGEMENTS

12.1 Next Meeting

The next meeting would be held in the Faroe Islands in February/March 2004. The Council **agreed** to determine the place and date by correspondence. Delegations thanked the Chair and the Secretariat for an efficient meeting.

12.2. The press release, summarising the main decisions and recommendations of the 2003 Annual Council Meeting as contained in Appendix 5 was adopted.

Appendix 1

AGENDA

1. Opening procedures
    - 1.1 Welcome address
    - 1.2 Opening statements
    - 1.3 Observers
    - 1.4 Adoption of agenda
    - 1.5 Meeting arrangements

2. Finance and Administration
    - 2.1 Report of the Finance and Administration committee
    - 2.2 Commission Budget 2003 & Forecast Budget 2004
      Final accounts 2001, Final accounts 2002
    - 2.3 Other business

3. Scientific Committee
    - 3.1 Report of the Scientific Committee
    - 3.2 Provision of advice on sustainable catch to the council
    - 3.3 Other business

4. Management Committee
    - 4.1 Report of the Management Committee
    - 4.2 Recommendations for requests for advice
    - 4.3 International Observation Scheme
    - 4.4 Other business

5. Hunting methods
    - 5.1 Report of the Committee on Hunting Methods
    - 5.2 Other business

6. NAMMCO Fund
    - 6.1 Report of the NAMMCO Fund
    - 6.2 Other business

7. Environmental questions

8. The NAMMCO Conference on User Knowledge – Scientific Knowledge in Management Decision-Making
    - 8.1 Report
    - 8.2 Recommendations

9. External relations
    - 9.1 Co-operation with other international organisations
    - 9.2 Other business

10. Information

11. Any other business

12. Closing arrangements
    - 12.1 Next meeting
    - 12.2 Adoption of press release

Appendix 2

LIST OF DOCUMENTS

NAMMCO/12/1	List of Participants
NAMMCO/12/2	Agenda
NAMMCO/12/3	List of Documents
NAMMCO/12/4	Report of the Finance and Administration Committee
NAMMCO/12/4 – Annex 1	Final Accounts for 2001, Final Accounts for 2002, Draft Budget 2003 Forecast Budget 2004
NAMMCO/12/5	Report of the Scientific Committee 17-19 September 2002
NAMMCO/12/6	Provision of Advice on Sustainable Catch to the Council
NAMMCO/12/7	Report of the Management Committee, 5 March 2003
NAMMCO/12/8	Report of the Committee on Hunting Methods
NAMMCO/12/9	Report of the NAMMCO Fund
NAMMCO/12/10	Report from the NAMMCO Conference User Knowledge – Scientific Knowledge in Management Decision-Making, Reykjavik, Iceland 4 – 7 January 2003
NAMMCO/12/11	External Relations
NAMMCO/12/12	Information
NAMMCO/12/13-1	NAMMCO letters regarding Sellafield
NAMMCO/12/13-2	NAMMCO letter to OSPAR regarding observer status
NAMMCO/12/13-3	Correspondence between NAMMCO and ICES
NAMMC/12/OS	Opening Statements from member countries and Japan

Appendix 3

Welcome Address

By Dr Grete Hovelsrud-Broda

Minister, Ambassador, Delegates, distinguished guests

On behalf of the NAMMCO Secretariat it is my pleasure to welcome you to the 12th meeting of the NAMMCO Council. This year the Council meeting is hosted by the Secretariat. For practical reasons we were not able to hold this meeting in Tromsø, which would have given us an opportunity to welcome you to the relatively new location of the Secretariat. It has been four years since the Scientific Secretary, Daniel Pike and I started working for NAMMCO, and we have just embarked on a second four-year period. It has been two and half years since Charlotte Winsnes joined us as Administrative Co-ordinator. As is often the case when a new period starts it is tempting to take stocks of the time that has passed and take a look into the future. However, this will not be a thorough review of the past nor a prediction for the future. Much has happened and much is yet waiting to happen. In looking back at the past four years we have had a number of administrative successes. Permit me to mention that the Host Agreement between NAMMCO and Norway, the first of its kind has been signed and implemented. The Secretariat has moved into a more visible location, and by being a part of the greater community of the Polar Environmental Centre in Tromsø is more visible locally and internationally. This is not only beneficial to NAMMCO as an organisation, but also improve the working environment for the Secretariat members.

NAMMCO is receiving due attention and recognition internationally. I would like to mention the NAMMCO International Observation Scheme, which is now fully functioning. The scientific publications based on the work of the NAMMCO Scientific Committee are widely recognised. NAMMCO work on marine mammal - fisheries interaction is receiving international recognition and increased interest by both managers' and scientists. And we are eagerly awaiting the results from the abundance estimates from the North Atlantic sighting surveys from 2001. The most recent Conference on User Knowledge and Scientific Knowledge in Management Decision-Making was deemed a success and firmly placed NAMMCO on the map as an organisation that takes whalers, sealers and other resource users seriously. This is in turn tied to NAMMCO as an organisation that in earnest considers sustainable utilisation of marine mammals as closely linked to sustainable communities. On the international arena this is reflected as one of the strengths of NAMMCO.

In looking ahead there are a number of areas where NAMMCO can make a difference. For one this can be done through the continuation of the work on marine mammal - fisheries interactions. Modelling ecosystems and such interactions are extremely difficult, due to the complexity of the systems and the need for extensive data on the actual consumption of the species in a given ecosystem. If we don’t have the biological understanding and data it become even more difficult to estimate and understand the economic aspects of such interactions. NAMMCO has an important role in this work, as the only intergovernmental organisations that asks these difficult

and controversial questions.

Another area of possible increased involvement is on the contaminant and pollution issue. We are being bombarded with scary scenarios on the contamination of foodstuffs from the sea. This is a very serious issue. However, I have found from listening to the experts presenting the depressing data at international meetings that part of the equation is missing. Granted, some of our marine mammals are contaminated and this is serious, but there are also benefits to consuming such foods. The benefits range from the direct health benefits of selenium and anti-oxidants found in marine mammals to the social and cultural benefits and human well-being of consuming such foods. In some cases the available alternatives to marine mammals as a staple are worse for the human health than the contaminants in the locally available foods. We need to now more about the drawbacks and benefits of marine mammal consumption, and the NAMMCO parties may in the future find it necessary to take the lead in such work.

I see the future role of NAMMCO internationally as expanding,
- through an increased interest and recognition of NAMMCO activities in general,
- through specific work of interest among nations with shared stocks or similar species with the same management and scientific problems, such as beluga, narwhal and grey seals,
- through maintaining the focus on sustainable resource use and sustainable communities and - through continued involvement of the resource users in the management decision-making process.

A lot could be said about the future scientific directions of NAMMCO, and I will simply note that important aspects include an increased focus on small cetaceans and on abundance estimates and sighting surveys. I do not wish to pre-empt Daniel Pike's presentation on the North Atlantic Sighting Surveys, and give the word to the NAMMCO Scientific Secretary.

THE NORTH ATLANTIC SIGHTINGS SURVEYS
COUNTING WHALES IN THE NORTH ATLANTIC
Welcome Address by Daniel Pike

The North Atlantic Sightings Surveys (NASS) are a series of cetacean surveys covering large areas of the Eastern and Central North Atlantic. NASS have been conducted in 1987, 1989, 1995 and most recently in 2001. The surveys have been international, including participation from the Faroe Islands, Greenland, Iceland, Norway and Spain. Their general purpose has been to estimate the abundance and describe the distribution of various species of cetaceans in the North Atlantic.

The NASS are perhaps the largest-scale wildlife surveys ever attempted, covering a maximum area of around 2 million square nautical miles, about the same size as Western Europe, and involving as many as 15 ships, 3 aircraft and 100 observers in a single survey. The distance covered by ships and planes while surveying has been as high as 40,000 nautical miles, a distance equivalent to about twice around the world.

As many as 5,000 whales have been seen in a single survey.

Why?

Early stock assessments of whales relied mainly on catch-per-unit-effort data from commercial whaling operations, as well as some limited data from tagging experiments. By the 1980's it was widely recognised that this was inadequate, mainly because the relationship between catch, hunting effort and the number of whales in the sea was not straightforward. Moreover, catch-per-unit-effort data was becoming less available as fewer countries engaged in whaling, and the International Whaling Commission (IWC) implemented a moratorium on commercial whaling in 1986. Therefore, dedicated research was required to estimate the abundance of whales in the North Atlantic and other areas.

The open sea has few obvious boundaries. Whales typically migrate over large areas and the area occupied by a single stock, even in a single season, may be huge. Their migratory paths and summering areas may vary greatly from year to year, making it difficult to interpret annual variations in numbers in small areas. In addition, many of the populations of large whales in the North Atlantic were thought to be recovering from overharvesting, and could therefore be expected to expand their range. It was therefore recognised that only a survey covering a very large area could have any hope of providing meaningful estimates of abundance, and describing trends in abundance over time.

Mounting a survey over such a huge area is challenging, particularly in terms of logistics. Finding enough ships, planes and qualified observers, and co-ordinating their activities in time and space is extremely difficult. The costs of such a survey are great, and the government agencies usually responsible find it difficult to devote large sums of money to projects that occur at irregular intervals of several years. Despite these problems, by 1987 the stage was set for the first internationally co-ordinated cetacean survey in the North Atlantic.

The surveys

NASS have been conducted in 1987, 1989, 1995 and 2001. The earliest surveys (1987 and 1989) were the largest, involving the participation of 5 countries: the Faroes, Greenland, Iceland, Norway and Spain (see Fig. 1). By 1995, Spain and Greenland were no longer participating and the survey area was consequently smaller. After 1995, Norway began surveying a portion of their area annually on a 6 year rotation. Therefore, by 2001, only 2 countries, the Faroes and Iceland, participated in NASS.

The NASS have been a model of international scientific co-operation. Planning meetings have been held before each survey to develop the general survey design and harmonise survey methodologies. The 1995 and 2001 surveys were planned through the NAMMCO Scientific Committee. The survey areas of each country adjoin but to not overlap, and all portions of the area are covered in the same time period. Data have been analysed with the oversight of the IWC and, for the 1995 and 2001 surveys, NAMMCO Scientific Committees.

The target species of the surveys have been fin whales (Iceland and Spain), minke whales (Iceland, Norway, Greenland, the Faroes), sei whales (Iceland 1989) and pilot whales (the Faroes). However sightings of all species are recorded. The choice of target species influences the temporal and spatial extent of the surveys, and to some extent the survey methods used. Ships have been used in most areas, however the coastal areas of Iceland and Greenland have been covered by plane.

Methodology

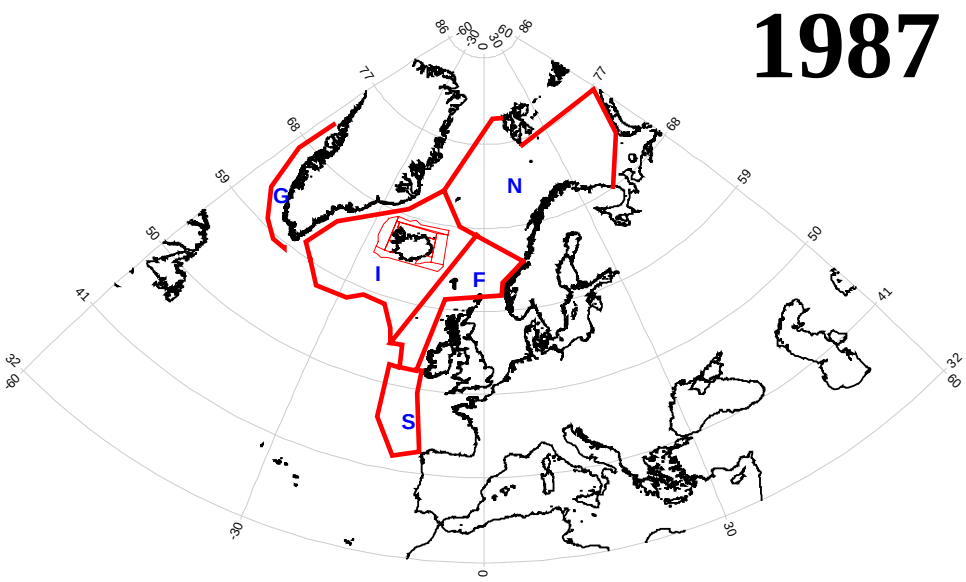
The field methods used in these cetacean surveys are certainly not "high-tech". The ship or plane cruises pre-set routes or "tracklines". Observers scan ahead and to each side for whales. When a whale is seen, the observer records the distance to the sighting, species, number in the group and other pertinent details. In some cases the vessel breaks off the trackline to approach the sighting to confirm species identification. All sightings are recorded, whether they are of the target species or not.

The distance to the sighting is the primary piece of data collected, because it is used to estimate the density of whales in the survey area. It is easier to spot things that are close than those that are far away. Therefore, more whales are seen close to the trackline than far away from the trackline. The functional relationship between distance from the trackline and the number of sightings is used to estimate the area that has been searched, usually known as the Effective Strip Width. This relationship is different for each species, and is affected by differences between observers and environmental factors such as wave conditions. For example, the Effective Strip Width is typically much narrower for the small and cryptic minke whale than for the large and more obvious fin whale, and narrower in rough seas than in calm seas. Consequently these factors must be taken into account when estimating whale density. The number of animals seen within the Effective Strip Width is in turn used to estimate density.

Of course observers are not perfect. They sometimes do not see whales that are visible. Therefore, on most surveys, two independent teams of observers are employed, searching simultaneously. The data from the two teams are used to estimate the number of sightings that are missed by observers. In addition, whales are diving animals, and some will be underwater when the ship or plane passes. This is a particular problem for long-diving species such as sperm and northern bottlenose whales. Correction factors must be developed for these species, using data on diving patterns obtained by tagging whales with radio transmitters. When correction factors cannot be applied, it is simply recognised that the estimated abundance has a negative bias.

Distribution, abundance and trends

It is easy to forget that detailed information on the summer distribution and abundance of cetaceans in the North Atlantic was for the most part unavailable before the NASS were carried out. While there were some descriptions of seasonal distribution from whalers, it was not known if this reflected the true distribution of whales or the activities of the whalers. The dedicated NASS provided the first large-scale descriptions of cetacean distribution in the North Atlantic.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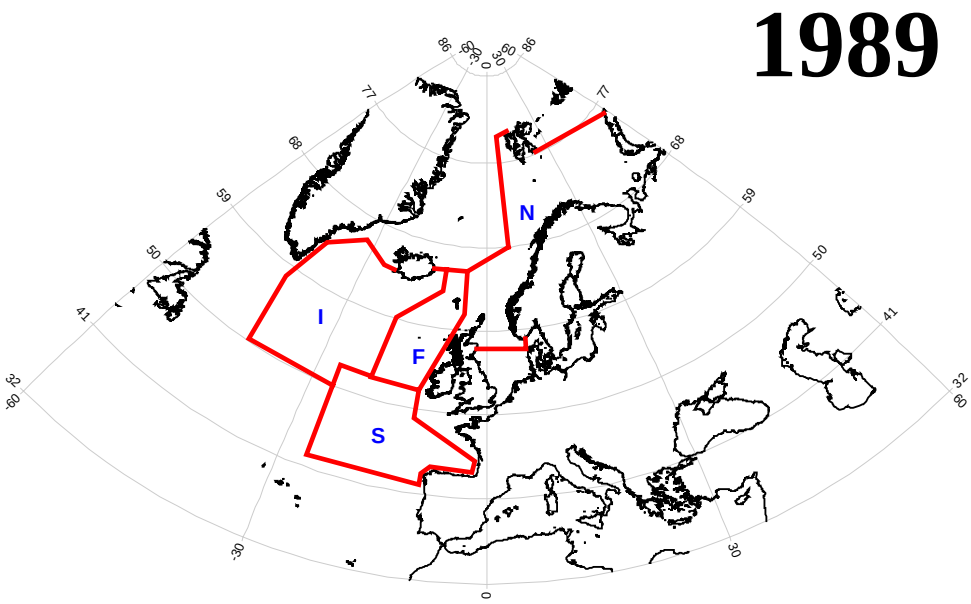
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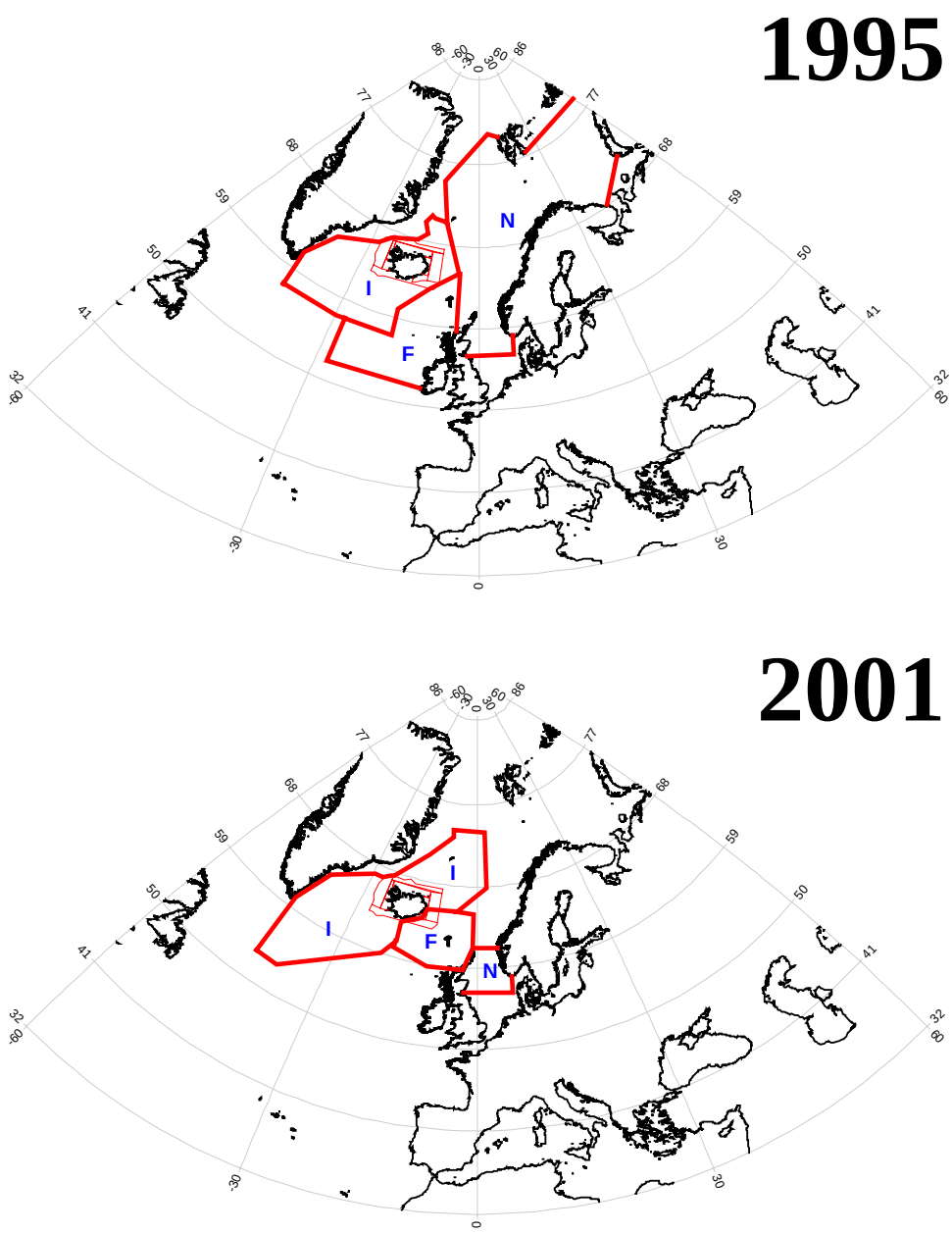

Fig. 1. The North Atlantic Sightings Surveys, 1987-2001. Blocks around coastal Iceland in 1987, 1995 and 2001 was surveyed by air while the rest was surveyed by ship. I – Iceland, F – Faroe Islands, G – Greenland, N – Norway, S – Spain.

The picture that emerged was a complex one. The minke whale tended to be most common in relatively shallow shelf waters, but was also found in offshore areas and near ice edges. The fin whale was most abundant in deeper offshore waters, especially in Denmark Strait between Iceland and Greenland. The humpback whale occurred in relatively high densities in discrete but limited areas, such as off northeast and western Iceland.

Whales are slow growing, long-lived animals. Populations grow relatively slowly compared to many other mammal species. The NASS have occurred over a time period of 17 years, which provides a realistic opportunity for detecting changes in abundance over time. The results for some species have been striking. Fin whales in the waters around Iceland and East Greenland have increased from around 15,000 in 1987/89 to over 25,000 in 2001. This increase may be a result of population growth after the cessation of whaling, and/or changes in distribution and abundance due to changes in the ecosystem. For humpback whales in Icelandic waters, the changes have been even more spectacular. In the first aerial survey carried out in 1986, only 19 humpback whales were seen. A total of 161 were seen in the 2001 survey, indicating an annual growth rate of 11% over the period.

For other species, little change in abundance has been seen. Estimates for minke whales have remained relatively stable, although changes in distribution have been noted. Blue whales remain very rare throughout the area. For sei whales, northern bottlenose whales and pilot whales, the timing of the surveys does not coincide with the seasonal peak of abundance in the survey area, so changes in abundance are difficult to interpret.

The importance of NASS

The primary use of the information gained from the NASS has been in the stock management of cetaceans. Data on distribution and abundance can be combined with catch data and biological parameters such as reproductive rate to model changes in the population due to exploitation. These models can be used to set sustainable harvest levels for the population. NAMMCO has used data from NASS in their assessments of northern bottlenose, pilot, minke and fin whales.

NAMMCO also attaches great importance to the potential interactions between cetacean populations and commercial fisheries. A prerequisite for assessing this interaction is detailed knowledge of the distribution and abundance of cetaceans in the area, and how they overlap with fisheries. This information combined with data on diet and energy requirements can be used to estimate the consumption by whales in a particular area.

Some species in the NASS area, such as blue and humpback whales, were severely depleted by past whaling activities. Only by repeating surveys over a long period of time can we effectively monitor the recovery or lack of recovery of these stocks. In addition, information on distribution is important in assessing the potential impact of human activities such as oil drilling, shipping and military exercises on cetaceans, and in monitoring the effects of climate change.

Future of NASS

It is a sad truth that there has been a steady erosion in the participation of countries in NASS, and in the spatial coverage of the surveys, since their beginning in 1987. A program that began with the participation of 5 countries now has only 2. The 2001 survey covered the smallest area of all NASS. With Iceland rejoining the IWC in 2002, the role of NAMMCO in the planning and analysis of future NASS is very uncertain.

Yet the need for data on the distribution and abundance of cetaceans remains, and large-scale, internationally integrated surveys are the only way to obtain it. It would indeed be unfortunate if the NASS series was discontinued just when it was beginning to generate important information on trends in abundance and the recovery of depleted stocks. So it is likely that large scale international surveys will continue in some form, and the next NASS has been tentatively planned for 2006.

Conclusion

In the difficult and contentious arena of "whale politics", the NASS have been a unique example of international co-operation towards the conservation and management of whale populations. The data collected in the NASS will retain their value both as a historical record, and as researchers find new ways to analyse and interpret the data. I predict that in 20 years time, researchers will still be using the NASS dataset in new and exciting ways. It is up to international organisations like NAMMCO and the IWC to work towards international co-operation on future surveys, to ensure that the promise of NASS is not lost.

OPENING STATEMENTS TO THE COUNCIL BY MEMBER DELEGATIONS AND OBSERVER GOVERNMENTS

GREENLAND – OPENING STATEMENT

Madam Chair, Delegates, Observers, Ladies and Gentlemen

On behalf of the Greenlandic delegation I would like to express our appreciation to be here in Norway for the twelfth meeting Council. As you all know, the utilisation of marine mammals is of great importance to Greenland, and we are gathered here because we believe that NAMMCO is a very important regional and international organisation for co-operation on sustainable utilisation, conservation and study of marine mammals in the North Atlantic.

With respect to marine mammal – fisheries interaction we should encourage the work by the Scientific Committee and try to focus on issues which may be utilised in a future ecosystem management.

Greenland is very engaged in the work regarding hunting equipment and hunting methods within the NAMMCO countries, and Greenland finds it very useful and important to collect and exchange knowledge on this issue with other member countries. Consequently, Greenland strongly supports to hold a workshop on seal

hunting methods in order to evaluate killing methods used and to determine minimum requirements for safe and efficient killing of different species.

Greenland also very strongly supports the NAMMCO Inspection and Observation Scheme. The six years of experience with the scheme has demonstrated that it is possible to establish and implement a well-functioning international Inspecting and Observation Scheme on whaling and sealing. Greenland therefore recommends that this scheme be further developed.

The NAMMCO conference on user knowledge and scientific knowledge in management decision-making was indeed very successful in bringing users, scientists and managers together to discuss how the difficult task of incorporation, on an equal footing, user knowledge and scientific knowledge into management decisions. In Greenland, the recommendations resulting from the conference is sought incorporated where relevant in a Greenlandic context. A first tangible result is an agreement between the scientists and the Organisation of Fishermen and Hunters in Greenland on committing into a formal co-operation between the two parties. It is very important that NAMMCO as well as the individual NAMMCO members continue working with the experiences and input given during the conference.

Thank you Madam Chair.

THE FAROE ISLANDS - OPENING STATEMENT

Madam Chair, Ministers, Delegates, Observers, Ladies And Gentlemen,

NAMMCO enters its second decade here in Norway this year at the twelfth meeting of the Council. The Faroe Islands continue to give NAMMCO highest priority when it comes to international co-operation on the conservation and management of marine mammals in the North Atlantic.

We believe the regional approach is the best way forward to ensure suitable development based on living marine resources. We are therefore encouraged to see that regional approaches to resource management and conservation were also stressed by the world community in the outcome of the Johannesburg World Summit on Sustainable Development in September last year. So too were ecosystems approaches- an area where NAMMCO has in many ways been at the forefront, having built ecosystem considerations into the very agreement on which our co-operation is based.

The valuable work carried out through the NAMMCO Scientific Committee continues to be the cornerstone of our co-operation. Although we believe that the assessments and advice of the Scientific Committee should also be made widely available to other interested organisations and institutes, we must remember that this work is generated by the Council, primarily for use in this regional management context. We have taken note of the committee's renewed for better-defined management objectives in order to provide the best possible advice, and we look forward to the discussion on this question at this meeting.

The role of user's knowledge has been a major focus on the recent NAMMCO activities, with the successful and well-attended conference held in January this year. We also look forward to further discussions on how to apply this increased focus in concrete management terms. How do we move from an academic discussion to finding practical ways on enhancing the science-based decision-making process by involving the users of the resources in this process? We must not lose sight of our overall aim and function as a management body to ensure sustainability in the utilisation of marine mammals. In the Faroe Islands we do take the user knowledge in our management decisions.

NAMMCO has for some time had a source of funding, through the NAMMCO Fund, for various information projects generated by private individuals and organisations. The importance of information for the general public has been on our agenda from the ver beginning. The Faroe Islands would like to see much greater priority given to NAMMCO's own role as a reliable source of up-to-date information for the general public on conservation status and management measures with respect to species and stock of marine mammals in the North Atlantic.

Finally, Madam Chair, I would like to extend my delegation's appreciation to the NAMMCO for hosting the meeting and to the Secretariat for their efficient preparations. We also would like to thank the General Secretary and Scientific

Secretary for their presentations this morning and express our appreciation to them that they are continuing with NAMMCO another 4 years.

ICELAND – OPENING STATEMENT

Madam Chair, Honourable Minister, Delegates, Observers, Ladies and Gentlemen.

It is with great pleasure that we travel to Asker to take part in the 12th meeting of NAMMCO. We have managed to find a place for our meeting that creates what we can call an 'island-situation'. That is a situation where those who attend the NAMMCO meeting stay together and are in a way closed off from the rest of the world. All this while staying very close to the Norwegian capital of Oslo.

NAMMCO has played, and continues to play, an important role in international co-operation for the conservation, rational utilisation and study of marine mammals in the North Atlantic.

While other elements remain important, NAMMCO's Scientific Committee has been particularly important. Iceland considers it to be vital that the good work being done will continue, as marine mammals are an essential part of the marine ecosystem.

Within NAMMCO we agree that marine mammals should be looked at in the same way as all the other components of the ecosystem. Unfortunately, in some other international fora there is a tendency to use subjective reasoning to give marine mammals a special status as being outside the ecosystem rather than an integral part of it. This tendency distorts the way we look at the world's oceans, and the objectivity on which NAMMCO is based, serves us better. This is of utmost importance for the NAMMCO countries, all of which are dependent on the utilisation of living marine resources.

The international community continues to place increasing emphasis on basing management decisions not only on evaluations of single stocks but on the marine ecosystem as a whole, to the extent possible. This was reconfirmed again last year at the World Summit on Sustainable Development in Johannesburg, South Africa. The biggest problem we face in applying this ecosystem approach is lack of information on the many components and interactions of the marine ecosystem. Iceland is confident that NAMMCO will continue to provide us with even better information on the marine ecosystem and continue to be a forum to consider how this information should be used in practice. The latter point includes looking at issues such as the roles of user knowledge and scientific knowledge. NAMMCO organised a very successful conference on that issue in Reykjavik early this year and will continue to look carefully at it.

This goes to the heart of NAMMCO. We are not interested in marine mammals simply because we are curious. We feel strongly that marine mammals should be utilised sustainable in the same way as all other living marine resources. The utilisation of living marine resources is essential for the societies in the NAMMCO area. The

sustainability of that utilisation is therefore of utmost importance, and for ensuring that the utilisation is sustainable international co-operation such as we have within NAMMCO is essential.

NORWAY - OPENING STATEMENT

Madam Chair, Minister, Delegates, Observers and Guests, Dear Friend

On behalf of the Norwegian delegation I would like to express to the NAMMCO secretariat for hosting the meeting in Asker in Norway. And even if the Norwegian Government does not host this NAMMCO-meeting, I'll take the opportunity to welcome you all to Norway. I'm convinced that our host, the NAMMCO secretariat has made every preparation possible so that the 12th annual meeting can be successful. However, it is in our hands to improve the tools for the management of our marine mammals through co-operation in this organisation. Definitely we have succeeded, but still we face several challenges.

At the annual meeting in Ilulissat in Greenland in February 2002 we celebrated the 10-years anniversary of NAMMCO. The nineties was a decade of development of international agreements and conventions for management of living marine resources. In spite of NAMMCO being a young organisation, it might be useful to look into the strategy for NAMMCO on the background of the development made in the nineties. As a participant dependent on the success of this organisation, Norway would like to see work done in order to discuss and draw the future strategy for NAMMCO.

One key issue for NAMMCO and its members is to broaden the knowledge of the marine mammals' role in the eco-system. Management based on an eco-system approach in the North Atlantic must of course include the marine mammals as a substantial part of it. Knowledge about interaction between different species is important, if we are to succeed in a sustainable and balanced management.

In Norway the Government gives priority to science in the marine sector which also leads to more effort in research in the field of marine mammals. Extended and targeted scientific research is vital for the future success for NAMMCO. This spring for instance we will launch a program for developing a new model for assessment of the minke whale-stock in the Northeast Atlantic. The model is based on data from DNA-analyses of the Norwegian catch.

The future of NAMMCO depends on the capability and willingness of the organisation to give adequate management measures when needed. Depleted marine mammals stocks will not only represent a threat for the stocks themselves and ruin the future for hunters and their communities, but also destroy he reputation and the future possibilities for our organisation. This risk we can not run.

Norway will, of course, contribute in mapping bycatch of marine mammals in fishing operations. A workgroup with representatives from the industry, the laboratory and the

management side are about to make proposals for changes in the form of the catch report to prepare for report on bycatch of marine mammals.

For the daily life of hunters is it important that we have an organisation that is able to create arenas were practical knowledge and advises can be offered and arenas were hunters have the opportunity to share their knowledge and experience with scientists and managers. The Conference on User Knowledge arranged by NAMMCO and sponsored among others by Nordic Council, created a basis for better dialogue and enhanced the users' involvement in decision-making processes. I welcome this development.

JAPAN - OPENING STATEMENT

The Government of Japan expresses its sincere appreciation for having been invited to participate as an observer at this Twelfth Meeting of the NAMMCO Council. We continue to share common view with NAMMCO members that scientific findings rather than emotion must be the basis of management regimes for the sustainable use of all living marine resources. While we have noted the significant achievements of NAMMCO and its members in this regard we have recently seen that better co-ordination of our effort is required in the face of opposition to this shared view.

Notwithstanding the fact that our shared view is consistent with the text of international conventions such as the International Convention for the Regulation of Whaling, the Convention in International Trade in Endangered Species of Wild Fauna and Flora and the Convention on Biological Diversity, many States Parties to these conventions continue to hold the position that marine mammals should be protected irrespective of their abundance and contrary to the widely accepted principle of sustainable use. Co-ordination of our efforts is therefore required in all fora related to the management of living marine resources.

In this regard, we congratulate Iceland on its membership to the IWC and hope that their presence will contribute to normalising the operations of that organisation. Japan has considered Iceland as a member of IWC since they deposited their letter of adherence to the 53rd Annual Meeting of the IWC which took place in London from July 23-27, 2001. We believe that Iceland's adherence with a reservation is fully consistent with international law and will continue to support their commitment to working constructively towards achievement of the objectives of the Convention.

Part of normalising the IWC will be the completion and implementation of the RMS and ending the inequitable treatment of whaling which permits whaling by aboriginal peoples and denies whaling by other coastal peoples. In this regard we will continue to monitor issues related to bowhead whaling particularly the scientific aspects which will be kept under review by the IWC's Scientific Committee.

In our statement to the Eleventh Meeting of the NAMMCO Council we noted that marine mammal interactions with fisheries have become a major issue in the context of world food security and fisheries resource conservation and management and

highlighted the attention given to this issue by FAO, particularly at the 24th Session of COFI and in the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem. Since that time, significant progress has been made.

FAO has held an Expert Consultation on Ecosystem –based Fisheries Management and preliminary guidelines were developed for an ecosystem approach to fisheries, focusing on fisheries management. These initiatives were supported at the World Summit on Sustainable Development held in Johannesburg, South Africa in September 2002, which emphasised the importance of adopting an ecosystem approach to managing natural resources, including reference to the Reykjavik Declaration.

NAMMCO and its Scientific Committee have played a leading role in promoting more effective management of marine resources through ecosystem approaches. This has included examining the issue of interactions between marine mammals and fisheries since at least 1996 when it concluded that minke whales, harp seals and hooded seals in the North Atlantic might have substantial direct and/or indirect effects on commercial fish stocks and most recently at its 2002 Workshop on Modelling Marine Mammal- fisheries interactions in the North Atlantic. The need for continuing research on this issue is highlighted by the statement in the report of the 2002 Workshop which noted that "while the principle of multi-species management seems to be widely accepted, the practical aspects of putting it into practice lag far behind the rhetoric."

We are pleased with co-operation between NAMMCO members and the NAMMCO Scientific Committee with Japan on the issue of interactions between marine mammals and fish stocks and look forward to strengthening this co-operation. It is our belief that Japan's whale research program in the north-western North Pacific, whose primary purpose is to examine the impact of whales on the fisheries resources, will provide the basis for improved marine resource management in an area where whales are increasingly abundant and consuming fish from declining fisheries that feed humans. Similarly, and as has been acknowledged by the IWC's Scientific Committee, Japan's research program in the Antarctic is producing valuable scientific information for the management of resources. We further believe that this research complements that of NAMMCO members and therefore appreciate past expressions of support for these research programs from NAMMCO.

Japan looks forward to continuing co-operation with NAMMCO members on these important matters.

Thank you.

Appendix 4

AUDITED ACCOUNTS FOR 2001 and 2002

1. PROFIT AND LOSS ACCOUNT (NOK)

	2002	2001
Income		
Contributions	2,940,000	2,940,000
Interest received (netto)	76,857	47,125
Book Sale	12,346	22,219
Employees Tax	72,222	84,656
Total Income	**3,479,055**	**3,455,027**
Expenditure		
Secretariat costs	2,761,214	2,847,466
Meetings	125,475	58,100
Scientific Committee	324,876	363,024
Projects, NAMMCO Fund	200,000	455,000
Conference	101,564	
Total operating expenses	3,513,129	3,723,590
Operating result	**-34,074**	**-268,563**

2. BALANCE SHEET 31 DECEMBER 2001 and 2002

Current assets		
Bank deposits (restricted 200,000)	808,901	556,487
Outstanding claims	121,244	127,407
Total assets	**930,145**	**683,894**
Current liabilities		
Employers tax deduction & tax	0	44,077
Creditors	25,898	19,106
NAMMCO Fund*	266,695	221,000
Other	290,908	19,000
Total current liabilities	**583,501**	**303,183**
Restricted equity		
Relocation fund	200,000	200,000
Total restricted equity	**200,000**	**200,000**
Distributable equity (General reserve)	**146,644**	**180,718**
Total equity	346,644	380,718
Total liabilities and equity	**930,145**	**683,894**

* The NAMMCO Fund account is audited separately.

Appendix 5

FINAL PRESS RELEASE

The North Atlantic Marine Mammal Commission (NAMMCO) held its 12th meeting 4 - 6 March 2003 in Asker, Norway. The meeting was attended by delegations from the member countries, the Faroe Islands, Greenland, Iceland and Norway, as well as observers from the Governments of Canada, Denmark, Japan and the Russian Federation. A number of inter-governmental and non-governmental organisations also attended the meeting.

- **Enhancing Ecosystem-based Management**

NAMMCO has been at the forefront of efforts to implement ecosystem-based, multi-species approaches to the management of living marine resources. The new Working Group on Enhancing Ecosystem-based Management will look at recent developments in this area and how these can be related to the work of NAMMCO. Non-member North Atlantic countries, in particular Canada and the Russian Federation, will be invited to participate in the Working Group.

- **North Atlantic Sightings Surveys (NASS)**

New abundance estimates for a number of North Atlantic whale stocks will soon be completed based on the results of the most recent North Atlantic Sightings Survey conducted in 2001. The North Atlantic Sightings Surveys are a series of large-scale whale sightings surveys that began in 1987. The surveys conducted in in 1995 and 2001 were co-ordinated by the NAMMCO Scientific Committee. These international surveys have covered much of the Northeast and North Central Atlantic, and provide a unique source of information on the distribution, abundance and trends in abundance of several whale stocks, including fin, minke, pilot, humpback, sei, northern bottlenose and blue whales. This information is crucially important in the management of whale stocks throughout the North Atlantic, and also in the assessment of their role in the marine ecosystem. NAMMCO will work to continue these surveys in the future, and to broaden their coverage to other areas of the North Atlantic.

- **NAMMCO International Observation Scheme**

NAMMCO is the only international organisation that has a functioning International Inspection and Observation Scheme for whaling and sealing. In 2002 whaling and sealing activities in the Faroes, Greenland and Norway were monitored. In 2003 shipboard observations of Norwegian minke whaling will be emphasised.

- **Seals**

NAMMCO will host a Workshop on Seal Hunting Methods in September 2004, in Tromsø, Norway. The Workshop will include participation from all NAMMCO member countries and other countries world-wide engaged in seal hunting. The Workshop will review existing seal hunting methods and identify ways to further enhance the efficiency of killing methods as well as the safety of hunters.

Next month the Scientific Committee will conduct a population assessment of all major grey seal stocks in the North Atlantic, including stocks in the USA, Canada, Iceland, the Faroes, Norway and the Scotland.

- **User Knowledge in Management Decision Making**

NAMMCO hosted a highly successful international conference on integrating user knowledge and scientific knowledge in management decision making in Iceland in January 2003. Based on the outcome of the conference, NAMMCO is working towards better incorporating user knowledge in the management decision making process.

1.2
REPORT OF THE COMMITTEE ON HUNTING METHODS

The Committee on Hunting Methods met on 31 January 2003 from 9:00 to 17:00 in the Home Office of the Faroe Islands in Copenhagen. Present were Jústines Olsen, Chairman, (Faroe Islands), Amalie Jessen and Kim Mathiasen (Greenland), Kristjan Loftsson (Iceland) Egil Ole Øen (Norway), and Grete Hovelsrud-Broda, and Charlotte Winsnes from the Secretariat.

1. Introductory Remarks and Adoption of Agenda

The Chairman of the Committee, Jústines Olsen, welcomed the Committee members to the meeting. The draft agenda was adopted and members of the Secretariat were appointed as rapporteurs.

2. Updates on hunting methods in member countries

A list of laws and regulations in member countries (NAMMCO/HM/2003-3), and a list of references on hunting methods (NAMMCO/HM/2003-4), had been provided in advance. Updated versions are contained in Appendices 1 and 2.

Faroe Islands

Olsen (Faroe Islands) reported that there had been no changes in the regulation on pilot whale hunting. The infectious salmon anaemia that had been detected in the Funningsfjørður last year, and which led to the closure of the fjord as a whale bay to avoid spreading of the disease, had now been eradicated and all closed whaling bays had been opened.

Greenland

Jessen (Greenland) reported that revisions to the new hunting regulations have been postponed until this spring. An addition has been made to the regulations giving title to the rifle hunt, which will cover all types of joint hunting efforts. The rifle hunt has not previously been included in the regulations. In response to the NAMMCO observer's comments, after his observation activities for the Joint Control Scheme in 2001, that the winch onboard the observed whaling vessels were undersized, the Greenlandic government now requires a minimum size winch for catching large whales. The municipalities will be responsible for evaluating each individual winch. The government is undertaking a general revision of the Executive Order on large cetaceans. In response to a request from the hunters the government is organising an extra whaling course for those who did not yet attend such a course. Jessen further reported that a hunter has made a detailed drawing of the handheld harpoon that can be ordered from the shipyard in Qaqortoq. Most hunters still make their own harpoons. The hunters in Greenland are very satisfied with the new harpoon grenades, except for the price, which remains high. Jessen informed that the harpoon grenades are stored in four ammunition depots around Greenland and must be transported to the villages and towns. Both the storage and the transportation are costly. Egil Ole Øen (Norway) believed that the new Norwegian harpoon grenade, Whale grenade 99, in principle could be stored and transported in the same way as rifle ammunition. He recommended that Greenland contact Henriksen Mek. Verksted in Tønsberg, for a

copy of its transport-regulations, which are based on the UN regulations on such storage and transportation. The first animal protection group has been formed in Greenland (Opik). The Executive Order on beluga, narwhal, walrus and other small cetaceans is under development. A hearing has been held and the Order is currently under consideration by the Council on Hunting. A new Executive Order on seals and polar bears is under development, and revisions are under way with respect to an Executive Order on Hunting Licenses. Shooting tests, which includes weaponry, is being introduced in Greenland. It will be required that the hunters demonstrate some knowledge about hunting before they receive their hunting license. The hunters are currently paying a small fee (30 DKr) for their license and the government is planning to raise the prices substantially to reflect the administrative costs.

Iceland
Loftsson (Iceland) informed the Committee that he had nothing to report from Iceland.

Norway
Øen (Norway) reported that only a few adjustments had been made to the current government hunting regulations for marine mammals. A new Council on Hunting had been formed, with members from all relevant interest groups and government agencies. The Hunting Council is user oriented and financed by the government.

3. Update on the Recommendations from the Workshop on Hunting Methods, 9-11 February 1999

The Chairman asked the members to present the status of each country's follow-up to the recommendations from the 1999 Nuuk workshop that were not reported at the last meeting.

Recommendation 2: Olsen (Faroe Islands) informed the Committee that shooting tests on dead bottlenose whales had showed that calibre 458 round-nosed full metal jacket ammunition was satisfactory for killing such whales.

There were a number of recommendations pertaining to Greenland.
Recommendation 3a: Jessen informed the Committee that Greenland is waiting for the guidelines for standardising methods on how to perform the shootings tests on beluga and narwhal before the tests can take place (see also Item 6 in this report.)

Recommendation 3b: With respect to the development of objective descriptions of hunting methods, Jessen noted that this is also a question of resources. Such descriptions, to be all inclusive of the various hunting methods and regional variations in Greenland would be a major effort to produce. The descriptions would have to be created in co-operation with the hunters in the different regions of Greenland, and must be adapted to the different hunting methods. Jessen suggested that Greenland could start with a set of main points that would cover the different methods and the different regions. The Committee agreed to this idea and noted that such descriptions would also be an important contribution to the cultural history of Greenland.

Recommendation 3c: Jessen further reported that the hand held harpoon had been

developed, drawings made and it could be ordered for manufacturing at the shipyards in Greenland.

Recommendations under 4, Baleen whale hunting, pertaining to Greenland:

Recommendation 4c: Jessen reported that more stores than KNI Pilersuisoq sell weapons and ammunition in Greenland.

Recommendation 4d: The Committee noted that Greenland's extensive work on improving the harpoon canons used in minke whaling had been acknowledged at the Workshop in Sandefjord in 2001, and congratulated Greenland on its efforts.

Recommendation 5: Jessen informed the Committee that the new law on animal protection in Greenland had been out to public hearing in the fall of 2002, and will be considered by the legislators in the spring of 2003.

4. Update on the Recommendations from the Workshop on Ballistics Sandefjord 13 -15 November 2001

At its 11th meeting in Ilulissat, Greenland in February 2002, the Council agreed to the Committee's following recommendations:

- To develop guidelines for methods used to undertake more controlled and standardised studies of the effect of different weapons and ammunition on different species.
- To harmonise weapons and ammunition types for different species with due considerations to variation in hunting conditions in the different countries.
- To focus on seals and seal hunting.

With respect to the first recommendation, the Committee decided after a lengthy discussion that Egil Ole Øen and Jústines Olsen would prepare a draft set of guidelines to be presented to the Council at its Annual Meeting in March.

With respect to the second recommendation the Committee agreed that the harmonisation of weapons and ammunition would start with seals, and would be a topic at the planned Workshop on seal hunting methods (see next recommendation).

With respect to the third recommendation the Committee decided to recommend to the NAMMCO Council that NAMMCO hold the Workshop on Seal Hunting Methods early September 2004, in Tromsø, Norway. The Committee agreed to the following Draft Terms of Reference for the Workshop:

- To review existing seal hunting methods known.
- To evaluate methods used in seal hunting in relation to killing efficiency and struck and lost rates
- To examine possibilities for technical innovation and further enhancement of efficiency and safety of hunting methods, with a view to providing recommendations for improvement, where relevant, and
- If possible, determine minimum requirements for safe and efficient killing of different seal species, considering variations in hunting methods.

The Committee agreed that the Workshop should be as inclusive as possible and include all forms of sealing in all NAMMCO member countries, and if possible Russia, Nunavut, NWT and other parts of Canada, Sweden, Scotland, Finland, Namibia and Alaska including the Pribilof Islands. The Committee agreed that the budget must include funding for interpreters and also a standard fee for the presenters. The presenters will be asked to consider issues such as struck and loss rates in relation to the different seasons, a description of the hunt, weapons and ammunition used, a general evaluation of the methods used, problems and advantages of the hunting methods, laws and regulations and training. The hunters would also be encouraged to bring visual materials such as videos of their hunting activities. The Committee agreed to charge the Secretariat with finding collaborators and sponsors for the Workshop.

5. Future Work of the Committee

The Committee agreed that their future work would focus more on seals and seal hunting methods. Furthermore an ad hoc working group was established (Olsen and Øen) to develop guidelines for "Shooting trials for verification of ballistic properties of different types of ammunition pertaining to penetration abilities into the skulls of different species of whales". The Committee also raised the issue of the killing methods of by-caught marine mammals, and invited the Management Committee on Bycatch to forward a request on this topic.

6. Representation at the IWC Workshop on Killing Methods.

Egil Ole Øen informed the Committee on the developments in the IWC Workshop on Killing Methods and noted that the next Workshop will be held 7-9 June, in conjunction with IWC 55 in Berlin this year.

7. Election of Officers.

Jústines Olsen was re-elected as Chairman for another two-year period. Egil Ole Øen was re-elected as vice-chairman for the same period.

8. Any other business

There was no other business.

9. Approval of the Report

The report was approved through correspondence on 19 February 2003.

Appendix 1

LIST OF LAWS AND REGULATIONS IN NAMMCO MEMBER COUNTRIES

updated June 2002

FAROE ISLANDS

Parliamentary Act	No. 57 of 5 June 1984 on whale hunting
	No. 54 of 20 May 1996 amending Parliamentary Act on whale hunting
Executive order	No. 19 of 1 March 1996 on exemption from protection of whales
	No. 126 of 23 June 1997 on protection of whales
	No. 46 of 8 April 1998 on pilot whaling
	No. 107 of 21 November 1989 on authorisation of whaling bays, as amended by executive order no. 64 of 11 May 1992, executive order No. 127 of 27 August 1992, executive order no. 141 of 23 June 1993, executive order no. 34 of 24 March 1994 and executive order no. 94 of 31 May 2001
	No. 166 of 27 August 1993 on provisional authorisation of whaling bays
	No. 118 of 23 October1996 on provisional authorisation of whaling bays
	No. 72 of 17 May 2000 on provisional authorisation of whaling bays
Parliamentary Act	No. 9 of 14 March 1985 on the protection of animals, as last amended by Parliamentary Act no. 60 of 30 May 1990
Parliamentary Act	No. 43 of 22 May 1969 on weapons etc. as amended by
Parliamentary Act	No. 54 of 12 May 1980
Executive order	No. 57 of 12 September 1969 on weapons etc.
Parliamentary Act	No. 128 of 25 October 1988 on hare hunting

GREENLAND

Greenland Home Rule Act no. 12 of 29 October 1999 on hunting.

Executive Order	No. 13 of 16 March 2001 on trophy-hunting and fishing
	No. 20 of 11 May 1994 on polar bear hunting in Greenland
	No. 30 of 11 October 1995 on beluga and narwhal hunting
	No. 6 of 29 February 1996 on revisions to Executive Order No. 30 of 11 October 1995 on beluga and narwhal hunting
	No. 26 of 24 October 1997 on extraordinary check and approval of harpoon canons
	No 7 of 26 February 1998 on protection and hunting of walrus
	No. 13 of 3 April 1998 on reporting from hunting and strike of large whales
	No. 12 of 3 April 1998 on hunting of large whales
	No. 4 of 1 February 2000 on hunting licenses for full time hunters
	No. 5 of 1 February 2000 on hunting licenses for part-time and/or sport hunters

Catch registration form (1993)

Greenland Parliament Regulations of 31 August 1959, ratified on 12 February 1960 on the protection of harbour seals (*Phoca vitulina)*

ISLAND

Whaling Act	no 26,May 3, 1949
Regulation	no 163, May 30, 1973 on whaling
Regulation	no 304, May 9, 1983 on amendments to Regulation No. 163 of May 30, 1973 on whaling
Regulation	no 239, May 10, 1984 on amendments to Regulation no. 163 of May 30, 1973 on whaling (cf. Regulation no. 304/1983)
Agreement	no 9 of 26. June 1991 between Iceland and Spain on an international observer scheme for land-based whaling stations in the North Atlantic area.

NORWAY

(Translation by the NAMMCO Secretariat)
Parliamentary Act of 16 June 1939 on whaling
Parliamentary Act of 3 June 1983 no 40 on ocean fisheries etc.
Law on Wildlife

Executive Order from the Director of Fisheries:

J-45-89, 14.3.89.	Regulation on control of the practice of seal hunting
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J-36-2001, 8.2.2001	Regulation on seal hunting in the West and East Ice in 2001.
J-45-2001, 1.3.2001	Regulation on the permission to hunt minke whales in 2001.
J-46-2001, 1.3.2001	Regulation on minke whale hunting in 2001.
J-74-2000, 31.3.2000	Regulation on the practice of hunting minke whales in 2000.
J-68-2001,27.3.2001	Regulation on maximum quotas for hunting minke whales in 2001.
J-160-2001, 3.8.2001	Amendment to regulation on maximum quotas for hunting minke whales in 2001

Instructions for inspectors during the minke whale hunt in 2001, 4.4.2001.

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1.3
THE NAMMCO CONFERENCE ON USER KNOWLEDGE AND SCIENTIFIC KNOWLEDGE IN MANAGEMENT DECISION-MAKING

Radisson SAS Saga Hotel, Reykjavík, Iceland 4 - 7 January 2003

Background

At its meeting in Ilulissat in March 2002 the NAMMCO Council endorsed the Secretariat proposal to hold a Conference on User Knowledge and Scientific Knowledge in Management Decision-Making, Reykjavik, Iceland 4 – 7 January 2003 (NAMMCO Annual Report 2001: 31). The background of the Conference was the apparent differences of opinion between whalers, sealers and fishermen (users) on the one hand, and scientists on the other. Disagreements and often direct conflicts exists between these groups with respect to resource management in general terms, and with respect to, for example, the actual numbers of animals found in an area, their migratory routes, feeding habits and biology. Management decisions are predominantly based upon scientific advice, although successful co-management programs exist. Both the type of knowledge held by users and scientists, and their ways of knowing are different. This increases the possibility of conflict and makes it difficult to find a common ground for solving questions of resource management. The Council recognised that a dialogue between scientists and users is of importance to the managers. A comparison of the two knowledge systems would establish how they are similar, and where they converge. The conclusions from this comparison will aid the discussion on how management decisions best can be based on both user knowledge and science. The goal of the Conference was to find ways to incorporate user knowledge into the management decision-making process in parallel with science.

Advisory Group

The programme (see Appendix 1) was developed by the Secretariat in co-operation with a Conference Advisory Group consisting of 2 members from each NAMMCO member country: Grete Hovelsrud-Broda, Chair, and Charlotte Winsnes (NAMMCO), Bjarni Mikkelsen and Ólavur Sjúðarberg, Faroe Islands, Amalie Jessen and Søren Stach Nielsen, Greenland, Droplaug Ólafsdottir and Kristján Loftsson, Iceland, and Bjørn Hugo Bendiksen and Lars Walløe, Norway.

Statistics and Budget

The Conference was deemed a success. This topic has previously not been addressed at such an international level and magnitude and NAMMCO has received favourable comments for addressing the topic. A unique group of more than 120 participants, among them hunters, fishermen, scientists, resource managers and others from the four NAMMCO member countries, Australia, Canada, Denmark, the Russian Federation, Sweden, France, the UK and the USA, attended the Conference (see Section 5.5 for list of participants).

Conference Costs and Funding

ITEMS	COSTS NOK
Cost speakers	143 388
Staff travel	67 289
Staff salary	156 250
Announcement, programme, conference folder, name badges	31 312
Communication, distribution	20 000
Conference dinner	89 855
Coffee breaks, meeting room	74 106
Interpretation equipment and personell	127 906
Russian delegation	67 810
TOTAL COSTS	777 916

FUNDING	NOK
Conference fee	79 360
Nordic Council of Ministers	256 609
Ministry of Foreign Affairs, Norway	75 000
Ministry of Fisheries Faroe, Islands	49 875
Indigenous Survival International Greenland	101 055
NAMMCO Conference Budget	216 017
TOTAL FUNDING	777 916

Generous in-kind support was received from the Ministry of Fisheries and the Institute of Marine Research, Iceland.

The Icelandic Ministry of Fisheries, represented by Stefán Ásmundsson hosted a reception for the Conference participants at the Radisson SAS Saga Hotel on the evening before the Conference. The Minister Hon. Árni Mathiesen, regrettably could not attend.

Key Topics

The key topics for the Conference were:

- National and international aspects of resource management, and the structure of the decision-making process;
- Existing projects on user knowledge involvement in management;
- How user knowledge and scientific knowledge is gathered, kept and transmitted and their strengths and weaknesses;
- An examination of the co-operation between scientists and users with respect to the utilisation of their knowledge; and
- The role and application of user knowledge and scientific knowledge in management decisions.

A short time was set aside for questions at the end of each presentation. In addition there were two dedicated discussion sessions, involving panellists and the open meeting. The topics for these sessions centred on 1) identifying the differences, similarities, strength and weaknesses of the two types of knowledge; and 2) finding ways to improve how user knowledge and scientific knowledge are incorporated in management decisions.

Summary of the main points covered in the presentations and the discussions
(Appendix 2, page 84).
It was recognised throughout that science is a critical element of management. Some argued that it is likely, within the current systems, to remain the main source of information for managers. This is because science is often considered to be a neutral and objective source of information. Some noted that this is not the case, and that science is also subject to the opinions and subjectivity of the scientists. Science was also perceived by some as limiting in some ways in that it has difficulty dealing with the complexities of the natural world. The scientific models, to work, must deal with simpler relationships than is found in nature. It was further recognised that user knowledge is important to the management decision-making process. It is not simply overarching biological and economic factors that are to be considered in management, but also socio-economy and sustainability at the local community levels. For this reason user knowledge becomes even more important to the process. There is tension between a top-down resource management approach, the local impact of management decisions and the lack of local involvement in the process.

There have been a number of community-based co-management initiatives in Alaska and Canada. It was a common thread throughout the Conference that user knowledge had contributed to and expanded the knowledge base of the issue in question. It was seen as a difficult process to document user knowledge, and seen as critical that the representation of such knowledge should not be filtered, interpreted or judged by the scientists. It is a major effort to document user knowledge, and it cannot be accomplished in a single workshop or meeting. In many of the studies reported the users were frequently found to distrust the scientists and were reluctant to give out information. User knowledge is seen as encompassing the complex relationships found in nature without needing proof. This in turn is often problematic for the scientists. It is also a challenge to synthesise complex relationships into informative and easily understood formats. Users through their intimate knowledge of the land and their environment are an extremely valuable resource for managers and scientists. The users should be involved in setting the management objectives and goals, selecting the local participants, and in designing the scientific studies. The examples presented at the Conference showed that the more the users were involved in the process the more interested they became in both research and management, and ultimately they more readily accepted the management decisions.

User knowledge is gained through experiences in the natural environment, and is based on oral tradition reflecting the past, present and the future. It is passed down through generations, and pertains to the environment as a whole. The accumulated knowledge from the past will always have to be fine-tuned to fit the present. The

concept of Inuit Qaujimjatuqangit (IQ) from Nunavut is one example of such knowledge. It is knowledge that has accumulated over many centuries, has evolved over time and is still used today in hunting and management practices and in the cultural aspects of Inuit life. A common thread amongst the users is that the natural environment is the source of physical and inner strength, is a link to people's emotions, and is intertwined with the cultural practises and traditions. Extensive knowledge of the land and the natural environment is also in many cases essential for survival. Hunters also exchange considerable information between themselves, however, such knowledge is not easy to record on paper.

Two presentations were devoted to the scientific enterprise, one discussing scientific principles and knowledge in general and the other illustrating in detail the scientific process in abundance estimates of harbour seals. Scientists formulate hypotheses, collect data, analyse and interpret data and draw conclusions. Like user knowledge scientific knowledge begins with observations of regularities in nature (empirical laws), and continues with trying to understand the interconnections between the different laws through theoretical laws. These laws are tested through educated guesses or hypotheses. In contrast with user knowledge it is usually the simplest possible explanation that is expressed. In physical science and more recently biology the explanation is expressed in mathematical terms. This poses a problem when such models are applied to practical situations. The managers are usually not aware of the many simplifications and assumptions that are embedded in the models. The simplified explanations of natural phenomena is a weakness but also a necessity for modelling interconnections. In contrast to user knowledge science does not attempt to account for all the complexities in the natural environment, although abundance estimates of a population involves a complex set of data. The data are gathered at many levels and for many factors, such as stock identity, pup count, human-induced and natural mortality, age structure, catch data, reproductive rates and pup production. Some of this information comes from the users. An abundance estimate gives an estimate of the current size of a population and allows for determining trends. It also allows for an estimate of sustainable harvest levels, and to determine the role of seals in the ecosystem.

The conflicts that are often experienced between wildlife management and wildlife research on the one hand and users on the other are in many cases due to different perspectives on wildlife and the environment. There are in many cases a lack of trust, co-ordination and understanding between the two groups, which creates barriers for co-operation. There are, for example, strong opposing viewpoints between the scientists and the Inuit with regard to the size of the polar bear population. In this case it was argued that science would need to increase the use of Inuit knowledge (IQ) if the goal is to establish effective polar bear management. User knowledge in general can provide guidance and experience in the process of interpretation and implementation of scientific data and methods. It is a challenge, however, to reconcile and maximise the use of both. In some regions it was pointed out that there are no fora where the users can share their information. Likewise there was no mechanism by which the government or the scientists could gather and utilise the experience that has been accumulated by the hunters. It is difficult when the scientists come to study the

natural environment and the resources important to the local people with a view of nature that calls for preservation. It is important for the scientists to recognise that their conclusions will have consequences for the users. In many instances there is no strict borderline between user and scientific knowledge, but the knowledge may be acquired from different sources. User knowledge is a valuable source of information, but does not constitute an alternative to quantitative scientific studies.

The application of good science in combination with user knowledge is likely to result in a stronger and more effective management regime. It was a general agreement that co-operation between users and scientists must start as early in the process as possible, and if no forum for co-operation exists, it must be created. Some cautioned that such formalisations must not hinder the scientific integrity. This is because the culture of science calls for objectivity and independence from the results of the research. Successful co-operation also entails that the information is brought back to and evaluated in the communities. Creating a management procedure is an iterative process, where the users should participate in setting the goals. It is not the scientists' job to participate at this stage. Both scientists and users should be involved in determining whether the data are available and obtainable. For the process to be effective the scientists develop the procedures and the users and managers develop the design. The advantages to users in having management procedures instead of ad hoc management are that the objectives are known, the data requirements are specified, and that it will ensure stability of catches. Some noted that the two systems are not really in conflict but are instead complementary, and that a dialogue between the two on resource management questions is imperative. It was repeatedly noted that there has to be a common understanding of the management goals and objectives, a common interpretation of the results and a development of a common terminology.

The notions of confidence building and trust were common threads through the presentations. Some governments have formed hunting councils in recent years, and others have formalised relationships with local and national hunting associations. The hunting councils include representatives from the hunting and fishing associations, from the industry, the scientific community and the ministries. In general terms these councils have input in most aspects of management, including regulations and quotas, giving the users a strong voice through the councils. When all stakeholders are brought together in a constructive discussion they have an opportunity to explain their perspectives and understanding to others with an interest in the same issue (the process of social learning). In this way important issues are not handled by experts alone, and other aspects, such as social and cultural, are brought into the discussion. An important aspect of the management decision-making process is formulating the questions, goals and objectives. The questions chosen will usually determine the answers one gets. It is highly likely that the involvement of users in formulating questions, goals and objectives will lead to better management.

The points of discussions summarised

- It is important to recognise the context of the knowledge, and that it is likely to differ between the scientists and the users.

- Indigenous use of resources is based on need and is part of a complex natural environment and cultural system.
- If user knowledge is to be incorporated into science it will be delivered as science. Do the users want their knowledge to be interpreted and presented to the managers by scientists, or do they want to deliver information that they have gathered and interpreted themselves?
- The cultural aspects of resource use must be considered more in management.
- It is not impossible to think that indigenous or local management schemes can lead to overexploitation. It is therefore important to study their management regimes in detail.
- Scientists and users belong to different cultures. In some user cultures advice and information is sought from respected elder. According to many users, the scientific culture always asks questions, but only include information that is relevant to science in its reports. Science requires reductionism and simplification of a much more complex reality where some of the components in the view of the user are irreducible. For the users their knowledge is holistic and pertains to all aspects of life. Therefore for a user a lot of information has to be included in order to understand and explain the context. This is inherently unsatisfactory to the scientists.
- Communication and humility are important ingredients for building confidence and trust between managers, scientists and users. To ensure success in communication both groups will have to accept the limitations of their knowledge.
- The managers are placed in the middle of the system, and should listen to both groups. But what should the manager focus on?
- There is a difference between incorporating user knowledge into management and integrating the same into science. Both should be equally respected, and have a role in resource management.
- User knowledge should be incorporated in two stages, first as valuable input in the scientific process, and secondly it should enter directly into the management decision-making process.
- If the objectives are the same or similar it is easier to communicate and understand each other. Hence more emphasis should be placed on developing management objectives. The users have a crucial role in developing such objectives.
- It would be useful to build capacity to gather user knowledge and create up-to-date and accessible databases. The information must be confirmed with the participants to avoid that the meaning is lost in the interpretations.

A number of common themes emerged from the presentations and discussions. The ad hoc drafting group prepared the following list:

Common Themes (not exhaustive)

- There is a need for involvement by the users in both scientific projects and in the management decision-making process. This involvement should be formal and maintained throughout the process starting with the design of the projects.

- There is a need for documenting the availability of user knowledge, its characteristics and how it works.
- Continuity and accountability are important to build trust between the parties. The concept of social learning was introduced as a methodology for achieving this.
- A significant investment of time, effort and money is necessary for the process to go forward. There are no simple, short-term solutions.
- All parties must show humility, and recognise the fallibility and limitations of both forms.
- Show a strong commitment to agreed-upon common goals and objectives.

Recommendations

1. An analysis of successful examples of incorporation of user knowledge in science and management should be undertaken. This could be compiled by NAMMCO in a book to serve as a valuable resource for NAMMCO member countries and others;

2. Specific advice should be given for specific cases, so that the advice is tailored to the local context of the management problem.

3. It is recommended that NAMMCO create an ad hoc committee to ensure the continuation of this work. This committee should also follow-up on the recommendations and developments in different areas. It would be helpful if others report to NAMMCO, and that the committee include people outside of NAMMCO member countries;

4. It is recommended that dedicated forums (such as the Alaska Eskimo Whaling Commission or the Nunavut Wildlife Management Board) are created and supported. The process of incorporating user knowledge in the management decision-making process cannot be ad hoc.

5. It is recommended that management decisions are made transparent and that they are explained. The reasons for the decisions must be explained, such as why certain information was rejected.

6. It is recommended to build capacity among users for all aspects of user involvement. It is important for the success of involving the users that they are allowed to speak for themselves.

7. It is recommended that relevant organisations strive for achievable steps to keep making progress. This can only be ensured through open communication and dialogue.

Conclusions from the Secretariat

The main focus of the Conference was to consider how user knowledge could be incorporated into the management decision-making process in parallel with science. This was addressed and considered to be of great importance to successful management. Many discussions also centred on how user knowledge can be better

utilised in the scientific process. This emerged as a parallel concern at the Conference. It became clear at the Conference that both issues are of vital importance for managing natural resources. The Secretariat recommends that in order to keep these issues moving forward NAMMCO should:

- Analyse existing resource management systems that incorporate user knowledge in the decision-making process. Such analyses must to a degree ignore the local context of each regime and focus on the more overarching elements that can be transferable to other regimes and areas,
- Develop a set of recommendations based in this analysis for how to incorporate user knowledge in the management decision-making process at the national levels, and
- Revisit the proposal for how to incorporate the knowledge of users in the advice provided by the Scientific Committee, and considers the procedures developed by the Scientific Committee in lieu of the results from the Conference.

Appendix 1

PROGRAMME

Saturday 4 January

17:00-19:00 Registration at Radisson SAS Saga Hotel

19:00-21:00 Reception hosted by the Icelandic Ministry of Fisheries at Radisson SAS Saga Hotel, ÁRSALURS

Sunday 5 January

09:00-09:30 Opening Session

Welcome by Amalie Jessen, Chair of NAMMCO Council

Opening Address Hon. Árni Mathiesen, Minister of Fisheries, Iceland

Introductory remarks: Grete Hovelsrud-Broda, General Secretary to NAMMCO

09:30-10:30 SESSION 1: Resource Management: An Overview.

Chair: Einar Lemche (Greenland)

Key Topics: Resource management in general terms, from the perspective of users and managers. The internal structures of national decision-making process, and examples of resource management. The international aspects, and the future of resource management.

Speakers

Kaj P. Mortensen (Faroe Islands) *The structure of* r*esource management in the Faroe Islands*, Jens Danielsen Greenland Fishing and Hunting Association (Greenland) *Resource management from a user organisation perspective* Stefán Ásmundsson (Iceland) *Resource management in Iceland and internationally* Halvard P. Johansen (Norway) *Resource Management: An Overview*, Steinar Andresen (Norway) *Science and Politics in international resources and environmental co-operation.*

11:00-12:30 SESSION 2: User Knowledge: Experience from Existing Projects.

Chair: Milton Freeman (Canada)

Key Topics: Description of projects focussing on user knowledge in management. What are the problems that have been encountered? What has been learned? Identify areas of improvement for future efforts.

Speakers

Henry Huntington (Alaska, USA) *The role of user knowledge in the Alaska Beluga Whale Committee*, Lucassie Arragutainaq, Sanikiluaq Hunters and Trappers Association (Canada) *Lessons learned from a community and ecosystem-based user knowledge study*, Charlie Johnson (Alaska, USA) *Projects using user knowledge in management*, Monica Riedel Alaska Native Harbour Seal Commission (USA) *Experiences on co-management from the Alaska Native Harbour Seal Commission* Vladimir Yetylin (Russia) *Traditional knowledge of Chukotka indigenous peoples and modern science: Providing mutual reinforcement.*

14:00-16:10 SESSION 3: User Knowledge

Chair: Søren Stach Nielsen (Greenland)

Key Topics: How the knowledge is gathered, kept and transmitted. What type of knowledge is gathered, the time depth, and for what purpose? What are the weaknesses of this type of knowledge?

Speakers

Meeka Mike (Nunavut) *User knowledge in Nunavut*., Max Kotokak Sr. (Canada) *User knowledge and the Joint Secretariat, Fisheries Joint Management - Inuvialuit Renewable Resources Committee, Northwest Territories,* Vladimir Yetylin (Russia) *Traditional knowledge of Chukotka indigenous peoples and modern science: Providing a mutual reinforcement,* Kalle Mølgård Greenland Fishing and Hunting Association (Greenland) *User knowledge in Greenland,* Nils Jørgen Nilsen (Norway) *Whaling and fishing: Experiences from Norwegian waters,* Jústines Olsen (Faroe Islands) How *user knowledge is gathered, kept and transmitted among pilot whale hunters in the Faroe Islands*

16:40-17:30 SESSION 4: Scientific Knowledge
Chair: Mark Nuttall (U.K.)
Key Topics: How the knowledge is gathered, kept and transmitted. What type of knowledge is gathered, the time depth, and for what purpose? What are the weaknesses of this type of knowledge?
Speakers
Lars Walløe (Norway) *Scientific Knowledge,* Garry Stenson (Canada) *Estimating abundance of seals in the North Atlantic: Designing and conducting a scientific assessment.*

Monday 6 January
09:00-10:30 SESSI0N 5: User Knowledge and Scientific Knowledge
Chair: Einar Lemche (Greenland)
Key Topics: The extent to which users make use of scientific knowledge and the extent to which scientists make use of users knowledge in their studies. Address the co-operation between users and scientists with respect to utilisation of knowledge.
Speakers
Hon. Olayuk Akesuk Minister of Sustainable Development, (Nunavut) *Inuit Qaujimajatuqangit and scientific knowledge in decision making,* Kalle Mølgård Greenland Fishing and Hunting Association (Greenland) *The role of scientific knowledge among hunters in Greenland,* Egil Ole Øen (Norway) *Utilisation of user knowledge in development and implementation of hunting gear,* Greg Donovan (U.K.) *Incorporation of user knowledge into management of cetaceans – experience from the development of an Aboriginal Whaling Management Procedure (AWMP) in the International Whaling Commission,* Jóhann Sigurjónsson (Iceland) U*ser knowledge and scientific knowledge in Iceland,* Dorete Bloch (the Faroe Islands) *Scientific use of user knowledge*

11:00-12:30 SESSION 6: Discussion: Panellists and Open Meeting
Chair: Mark Nuttall (U.K.)
Key Topics for Discussion: The differences, similarities, strength and weaknesses of user knowledge and scientific knowledge.
Panellists
Amalie Jessen (Greenland), Garry Stenson (Canada) / Lars Walløe (Norway)
Hans Jacob Hermansen (the Faroe Islands), Charlie Johnson (Alaska, USA)
Milton Freeman (Canada)

14:00-17:10 SESSION 7: Management Decision-Making Process PART I
Chair: Halvard P. Johansen (Norway)
Key Topics: The information sought in management decisions, and where the information is collected. The process of drafting regulations.
Speakers
Kaj P. Mortensen (Faroe Islands) *Management and drafting regulations in Faroe Islands,* Kim Mathiasen (Greenland) *Management and drafting regulations in Greenland,* Kolbeinn Árnasson (Iceland) *Management and drafting regulations in Iceland,* Lisbeth Plassa (Norway) *Management and drafting regulations in Norway*

16:00-17:10 SESSION 7: Management Decision-Making Process PART II
Chair: Halvard P. Johansen (Norway)
Key Topics: The role and application of user knowledge in management decisions. The role and application of science in management decisions.
Speakers
Kjellrun Hiis Hauge (Norway) Different ways of knowing: Problems and possibilities
Henry Huntington (Alaska) *The challenges of management decisions: A case from the Alaska Eskimo Whaling Commission,* Michelle Wheatley (Nunavut) *Wildlife management in Nunavut: Integrating Inuit Qaujimajatuqangit (Traditional Knowledge) and science,* Amalie Jessen (Greenland) *User knowledge, scientific knowledge and the management decision-making process in Greenland*
Guðríður Margrét Kristjánsdóttir (Iceland) *The management decision-making process in Iceland*

20:00 Conference Dinner

Tuesday 7 January
08:30-10:30 SESSION 8: Discussion: Panellists and Open Meeting
Chair: Milton Freeman (Canada)
Key Topics for Discussion: Are there ways to improve how user knowledge and scientific knowledge are incorporated in management decisions. Can the two knowledge systems play complementary roles in management decisions?
Panellists
Henry Huntington (U.S.A), Julia Green (Australia), Monica Riedel (U.S.A) Vladimir Yetilyn (Russia), Søren Stach Nielsen (Greenland), Einar Lemche (Greenland)

11:00-12:00 SESSION 9: Conclusions
Chair: Grete Hovelsrud-Broda (NAMMCO)
Panellists, chairs and the drafting group will present their concluding remarks, and address how the issue of better utilisation of user knowledge in management decisions can be moved forward. The meeting adjourns.

Appendix 2

SUMMARY OF PRESENTATIONS

Opening Session
Welcome by Amalie Jessen, Chair of NAMMCO Council
Opening Address Hon. Árni Mathiesen, Minister of Fisheries, Iceland
Introductory remarks Grete Hovelsrud-Broda, General Secretary to NAMMCO

The Opening Session on Sunday 5 January began with a welcome address by the **Chair of the NAMMCO Council**, **Amalie Jessen**. She noted that the value of user knowledge has been recognised in relation to resource management in the last 2-3 decades. There is a clear need for better co-ordination and dialogue of the knowledge held by users and scientists in order to minimise the conflict that often emerges between these groups. Also from a managers perspective it is important that the users and scientists co-operate and that their knowledge is seen as complementary. The topic of the Conference has been on the NAMMCO agenda since its establishment in 1992, and this is the first time, but probably not the last time a Conference on this topic is being held.

Ármann Kr. Ólafsson held the Opening Address on behalf of the Hon. Árni Mathiesen, Minister of Fisheries, Iceland. The Minister noted in his address that a comprehensive understanding of the marine ecosystem is lacking and that this is a necessary requirement to achieve sustainable fisheries. This is also stated in the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem adopted at the Reykjavik Conference, held by the UN Food and Agriculture Organisation and the Icelandic government in 2001. Because of the number of factors that enter into an understanding of the marine ecosystem, including those that are external to the system, it is important to make use of all relevant forms of knowledge in the process. No single approach provides all the answers. It is important to trust science while at the same time considering the knowledge of those utilising the resource and link the two both in the endeavour to understand the marine ecosystem and in the management decision-making process. User knowledge is often found to be available in advance of scientific knowledge, and is made use of on a daily basis in connection with general management issues and the application of technical measures. Both forms of knowledge possess extensive and valuable information, albeit of different sorts. The varying perspectives often lead to friction, but the aim is to have regard for both. This Conference will without doubt increase the co-operation between scientists and users and their common understanding of the issues.

The General Secretary to NAMMCO, **Grete Hovelsrud-Broda** in her introductory remarks thanked the minister for his words and the participants for coming to the Conference. She explained that the idea for the Conference had been maturing for some time, and recognised that it is not a new idea in resource management. It is unusual, however, to gather such a diverse and highly skilled group of people from so many nations. NAMMCO has high expectations from the Conference and hope for a strong set of recommendations on how to move forward on this very important issue.

Session 1, Resource Management: An Overview, Chair Einar Lemche (Greenland)
Key Topics: Resource management in general terms, from the perspective of users and managers. The internal structures of national decision-making process, and examples of resource management. The international aspects, and the future of resource management.
Speakers:
Kaj P. Mortensen (Faroe Islands) *The structure of* r*esource management in the Faroe Islands*, Jens Danielsen, KNAPK - Greenland Fishing and Hunting Association (Greenland) *Resource management from a user organisation perspective. S*tefán Ásmundsson (Iceland) *Resource management in Iceland and internationally* Halvard P. Johansen (Norway) *Resource Management: An Overview.* Steinar Andresen (Norway) *Science and Politics in international resources and environmental co-operation.*

In his opening remarks **Mr Lemche** noted that resource management often begin when it has become necessary to take drastic and controversial measures. Typically management is targeted towards single species because we have inadequate knowledge about multi-species interactions. Users often act as pressure or lobby groups towards the managers rather than presenting their knowledge and information, with the result that the managers do not focus on the user knowledge. With respect to resource management it is easier to transform international agreements to national rules, rather than having restrictions on a resource being handled only at the national level.

Kaj P. Mortensen (Faroe Islands) *The structure of resource management in the Faroe Islands.* In the Faroe Islands the Commercial Fishery Act of 1994 regulates fisheries. Under the Act living marine resources in the Faroese Fishing Zone and Faeroes allocations in waters outside the FFZ is the property of the Faroese people. The Act contains all elements of fisheries management including user knowledge and scientific knowledge. It states that the utilisation of the living marine resources should be sustainable both in biological and economic terms, and that Socio-economic factors are important to consider. Marine mammals are regulated by national legislation. Fisheries are regulated on the basis of the size of the fleet, which hold the fishing licenses. Quotas are given in number of fishing days and not in tonnes, a decision that once received unanimous support from all fisheries organisations. The Committee on Fishing Days, consisting of representatives of the ship owners and the unions monitor the system continuously to ensure statutory requirements of biological and economic sustainability. In this way the users are involved in the management process. The stakeholders are involved in the monitoring, reviewing and advising on the regulatory system. They are heavily involved in the management system both in the design and in filtering the scientific advice in preparation for political decisions. The advantages of the system are that it minimises the risks of discards and forged statistics, and allows for some flexibility between main stocks over a number of years. An inherent problem in the system is to monitor fishing power as technology changes. The number of fishing days may have to be adjusted to account for such changes. One goal for further improvement is to extend the system to all Faroese fishing vessels. Scientific advice and input from users are crucial in this regard, and for understanding the

impacts of increased harvesting capacities. It is widely recognised in the Faroe Islands that involvement of the fishers is required.

Jens Danielsen (Greenland) *Resource management from a user organisation perspective.* Resource management in Greenland, as seen from a user perspective, is often a source of conflict between users and managers. This is because the regulations by the central administration are often not in agreement with the traditional knowledge held by the hunters, and therefore appears to be one-sided. It is important not to disregard users knowledge that has been passed down from generations. Hunters and fishermen are partners with nature, with an intimate knowledge about their partner. It is a relationship of respect and care, like in a marriage. From a hunters perspective it seems that management is dominated by a western view of nature and an excessive desire for control over the resources. For example, in Greenland management of large whales takes place through the IWC, which has members from nations with no history of whaling. But Greenland who subsists on hunting whales cannot vote in the IWC. With respect to management of whales Greenland is a nation subject to colonial rule. This is also reflected in the case of the humpback whales in Greenlandic waters. The hunters have observed that the numbers are increasing while the biologists claim the opposite. It is the word of the biologists that counts in management and that is what the world is told. The hunters' knowledge is ignored. This illustrates that scientific methods have weaknesses and can be limited. The hunters claim that the scientific knowledge at times does not correspond with their own experiences. KNAPK strongly believes that there is a need for scientific knowledge about animals and their environment, but that it should not be the only knowledge utilised by the managers in Greenland. Currently scientific knowledge is taken more seriously than that of the hunters. Hunters wish to be more involved in research projects in general. KNAPK does not trust the Greenland Nature Institute, because they feel that the institute does not have the expertise to deal with the vast and unpredictable Greenlandic environment. Not only the scientists but also KNAPK and the Hunters Council must be consulted about management regulations. Such consultations should not be left to scientists and experts from abroad. One example is the regulation on birds, which was revoked after the Ombudsman discovered that it was not based on the traditional knowledge of the hunters, but only on scientific knowledge and the knowledge of outside experts. This illustrates that the users are subject to a colonial attitude "from above and from the outside". It must be remembered that the main source of income for most people in Greenland is derived from using the living resources. It is therefore critical that the traditional knowledge of hunters and fishermen must be utilised more broadly than today. This can be done through empowering the municipalities in the regions more than before, which will enable local fishermen and hunters and their associations to take more responsibility.

Stefán Ásmundsson (Iceland) *Resource management in Iceland and internationally*. All marine living resources are limited. Utilisation therefore must be managed to ensure sustainability. Free and open access would lead to disaster for the resources. The questions are about how the resources should be managed, who has the duty, who has the right, and who has no business in the management. The question of who depends on the type of stock and on and the jurisdictions involved. There are 4

categories: 1 Stocks that occur only within jurisdiction of one coastal state, 2 stocks that occur within the jurisdiction of two or more coastal states, but not on the high seas, 3 stocks that occur both within the jurisdiction of one or more coastal state and on the high seas, and 4 stocks that occur only on the high seas. In the first category states have simple jurisdiction. Management of stocks in the second category imposes the states a duty to co-operate. The third category includes states that fish on the high seas. Coastal states have a right to participate in such management even if they are not utilising the resources. In the fourth category only the states that take part in the fisheries have a right to manage. Coastal states, states that have catches on the high seas, and states that have been given the right in a special agreement have the right to take part in the management of living marine resources. There are special provisions for the management of marine mammals. Their utilisation can be managed more strictly than is otherwise the norm. States shall work together on the management of cetaceans through organisations. The United Nations Convention on the law of the Sea, Article 65 stipulates that states "shall co-operate with a view to the conservation of marine mammals and in the case of cetaceans shall in particular work though appropriate international organisations for their conservation, management and study." The obligation to work through organisations can result in states that normally would not have the right to take part in management getting that right through membership of an organisation (e.g. IWC has members who are not even coastal states). The right of those states is not based on international law but on their rights under the IWC Convention. International law sets the framework for the management of the utilisation of living marine resources and makes clear who's right and duty it is, but does not specify how the management should be done.

Halvard P. Johansen (Norway) *Resource Management: An Overview*. Sustainable management of living marine resource is a prerequisite for a profitable fishing industry. The fishing industry is expected to create job opportunities in remote communities along the Norwegian coast. An important feature of the Norwegian management policy is that the industry and the users as well as the scientists are closely involved in the decision-making process. Such involvement gives credibility and legitimacy to the process. The most important aim of management is sustainable communities and stable harvesting conditions. The management procedures are based on scientific surveys, recommendations from scientists, expert advice to the Minister of Fisheries and a political decision on quotas and allocations. Fishermen and hunters are formally involved in the process by having representatives from their organisations on councils and boards that give advice to the authorities. Consultations also take place at annual meetings, nationally and regionally. When setting quotas Norwegian managers consider the interaction between the different species in the ecosystem, including that of other predators. Internationally there is general agreement among nations on the principles for the management of marine living resources, but there is fundamental disagreement on how to do it. The differences are based on cultural preferences and emotions, and among nations whales are seen as charismatic mega fauna that are to be excluded from management. Policy makers must take into account the strong interest in the world community in certain species such as whales and seals, and be prepared to carefully explain their decisions for harvesting. Users and others interested will only accept decisions if they understand the rationale behind it. Nations

have an obligation to apply the international agreements the way that they were intended. To do otherwise could harm wildlife management in general and also important cultural traditions. Norway has chosen a policy that will normalise whaling and sealing and trade of products. The whaling industry has stabilised with products available throughout the country and with some exports. The sealing industry is in worse shape, with the lack of a well functioning market as the main obstacle. It is necessary for Norway to conserve the art of sealing until the market stabilises. Continued use of subsidies in order to preserve the sealing industry may be worthwhile, as we know that seals stocks are important predators on commercial fish stocks. Because sealing and whaling are both being scrutinised according to values not shared by Norway, it is important to do the right thing and be able to defend management decisions.

Steinar Andresen (Norway). *Science and Politics in international resources and environmental co-operation.* Despite the fact that people have been harvesting and living with natural resources for thousands of years before science became a reality, their knowledge is usually not the main source of information for management decision makers. And science in the narrow traditional sense is likely to remain the main source of information in the foreseeable future (e.g. consider the analogy with natural medicine to traditional textbook medicine.) The assumption is that science is neutral and is often seen as a counterweight to short-term economic interests, and drive for profit (e.g. Harding's "tragedy of the commons"). Unless we have fairly good knowledge about the resources in question, management tends to be based primarily on luck. Science is recognised as the major supplier of relevant knowledge for decision-makers in the resource management process. Scientific bodies have been established to various degrees as an integral part of the decision-making system (in the regimes studied). There is however, a tendency towards broadening the range of scientific inputs requested. While moves to exploit uncertainty or favour-based interpretations are common, open and explicit challenges seem to be rare. Scientific consensus usually spurs a response from the governments, but scientific evidence is not a sufficient condition for collective action. Conclusive evidence is not necessary for collective action. Science can be seen as a supplier of warnings serving as spurs for protective measures. Factors accounting for the impact of scientific input include the following: that the conclusions are consensual vs. controversial; whether a feasible cure is available or not i.e. can the problem be fixed by technology; whether the effects are close in time and social space vs. remote: whether the problems affect the centre or the periphery; whether the conflict has high or low political conflict. In case of the whaling issue, varying values have lead to a deep conflict. Most values are not negotiable and whenever a conflict focuses on basic values, (natural) science is likely to be sidelined. Nevertheless science has developed over time in this environment. Science needs alternative and supplementary sources of knowledge in resource management. It would also be beneficial if science and user groups work together against short-term economic interests.

Session 2 User Knowledge: Experience from Existing Projects.
Chair: Milton Freeman (Canada)

Key Topics: Description of projects focussing on user knowledge in management. What are the problems that have been encountered? What has been learned? Identify areas of improvement for future efforts.
Speakers:
Henry Huntington (Alaska, USA) *The role of user knowledge in the Alaska Beluga Whale Committee*. Lucassie Arragutainaq, Sanikiluaq Hunters and Trappers Association (Canada) *Lessons learned from a community and ecosystem-based user knowledge study*. Charlie Johnson (Alaska, USA) *Projects using user knowledge in management.* Monica Riedel Alaska Native Harbour Seal Commission (USA) *Experiences on co-management from the Alaska Native Harbour Seal Commission*
Vladmir Yetilyn (the Russian Federation) *Traditional knowledge of Chukotka indigenous peoples and modern science: Providing mutual reinforcement*

Henry Huntington (Alaska, USA) *The role of user knowledge in the Alaska Beluga Whale Committee.* The Alaska Beluga Whale Committee has documented user knowledge of beluga whales in three sites, expanding the scope of knowledge of beluga behaviour, biology, ecology and changes over time. As a part of the project managers, scientists and users sat together discussing the available information. The study learned that it is very difficult to document traditional (or user) knowledge. In the study the knowledge was not be filtered, interpreted or judged by scientists and the end product was their own representation of their own knowledge. In so doing, the process of documenting knowledge helped some hunters feel more engaged in the co-management process, thus enhancing the ability of the Committee to address research and management issues. It is critical for the process that all the participants are open to new ideas. In designing a project the scientists may not be aware of, or understand the connections in the natural environment seen by the users. Consequently the users should be involved from the beginning in designing the projects, setting the research agendas and contributing to the process. Documenting traditional knowledge is a major effort that cannot be accomplished in a single workshop format. Continuity is critical for this to be effective. It is also useful to examine methods that have been used in the past for similar projects. The beluga study shows that the documentation and use of user knowledge leads to engagement of users in research and management. It is not necessary that the researchers involved are independent of the management process, as long as there is a level of trust. It was also found that the users were more willing to accept and support the management decisions, which is necessary to make enforcement possible. Users, managers and scientists need to set common goals for the management and consider the questions that need answering. The encouragement of strong participation has created a strong alliance of hunters and government managers, all committed to the common goal of protecting beluga whales.

Lucassie Arragutainaq, Sanikiluaq Hunters and Trappers Association (Canada) *Lessons learned from a community and eco-system-based user knowledge study.* The Sanikiluaq Hunters and Trappers Association has, since the 1980s, been involved in community-based initiatives to combine user knowledge and scientific knowledge in management decision-making. The projects include a reindeer project, eiderdown harvesting in co-operation with the Canadian Wildlife Service, and the Hudson Bay Program focusing on the bio-region related to the Hudson Bay hydro-electric project.

The traditional knowledge programs were aimed at understanding the changes in the environment. Respectable elders and hunters were selected on the basis of trust in their knowledge. The problems encountered by these projects can be summarised as follows: 1) the scientists thought of the Traditional Ecological Knowledge (TEK) as "old wives tales"; 2) the participants felt distrust for the scientists and were cautious in giving the information; 3) a lot of information was gathered, but not enough time to consider it all; 4) the work on the TEK was looked down upon by the scientists because no proof was presented. A clear difference between the scientists who require proof in order to believe something and the users who respect what the hunters and elders say. Through the project they learned that user knowledge is complex and involve the whole environment, peoples lives and economy and their feelings about the environment and wildlife. It is clear from this work that the people involved must learn to ask the right questions and to stay on the topic. It was a challenge to synthesise complex traditional ecological knowledge into informative and easily understood formats. The presentation of the information and material was difficult and remains an unsolved issue for how to do this the best way. Another lesson learned is that this is only the tip of the iceberg because all knowledge of life belongs in the category of traditional or user knowledge. Recommendations: Need to know what you want - Select people who have knowledge - Don't use survey techniques (people give opinions) - Give something back to the contributors - Bring users and scientists together in a positive environment to talk

Charlie Johnson (Alaska, USA) *Projects using user knowledge in management*. In Alaska the US Fish and Wildlife Service has management authority over polar bears, and estimating the population has always been a considerable challenge due to the polar bears migratory patterns. In the late 1990s the Service realised that the local hunters held considerable knowledge about feeding areas, migration and travel routes and den sites by season. It began a program where the hunters were interviewed and noted what they knew about the polar bears on a map. Scientists assisted with design of the project. The result has been that critical habitat areas have been identified for protection. The hunters groups manage the hunts according to the results. A similar study on the Polar Bear Habitat Use in Chukotka has been conducted were more than 65 hunters have been interviewed. The sufficient number of interviews is 3-4 hunters per village, after that the information is duplicated. Alaska shares populations with Canada and Chukotka. Local people of Chukotka have been trained in interview techniques, and documenting the activities of the polar bears by season, as mentioned above. A problem in Chukotka is the lack of map resources. The hunters' information about the polar bears has revealed that the polar bear dens are multi-chambered, with a toilet, playroom and a bedroom. Russia will open for a legal polar bear hunt, and the results from the studies are being used in developing the Polar Bear Management Plan for Chukotka in identifying critical habitat and protected areas, seasons and other regulations.

Monica Riedel Alaska Native Harbour Seal Commission (USA) *Experiences on co-management from the Alaska Native Harbour Seal Commission*. The Alaska Native Harbour Seal Commission is a tribal consortium comprised of native communities within the habitat range of the harbour seals. It is funded through congressional

appropriation. In modern life, harbour seals continue to play an important cultural and nutritional role. To manage the seals the ANHSC follows traditional conservation measures, which includes seasonal takes. A co-management agreement is in place between National Marine Fisheries Service (NMFS) and the ANHSC. The Agreement is authorised by the tribes. The management decisions are based on co-equal participation, mutual respect and consensus. The meetings between the parties are held twice a year or as needed. A harvest rate assessment study is ongoing with 62 villages involved. The hunters provide biological samples for the scientists. The ANHSC and NMFS Co-management Committee is currently working on issues such as stock assessment and the need to draw new stock boundaries. The ANHSC is not convinced that there may be 12 or more genetically distinct stocks of Harbour Seal, and a review of the data is being conducted. More stock divisions lead to lower quotas and more science. The NMFS is being pressured by environmental groups to list the harbour seals under the US Marine Mammal Protection Act. More data on the harbour seals is needed with respect to traditional knowledge on movement, prey and population surveys. A number of problems have been encountered in this process. These include lack of trust between agencies and users, the geographical expanse of the species, complex agency regulations, which can be difficult to learn, no evaluation process for the Action Plan, low confidence range of the harvest data, and logistical barriers with the bio-sampling. The lessons learned from the Co-management Committee work shows that the participants must be open-minded and not too critical. It is also important to be consistent between areas and maintain contact regularly. It is necessary to understand how the agencies work, and their constraints. A process is needed for evaluating research plans. Recall surveys have proven not to be sufficient. It is therefore necessary to create a harvest data calendar, and maintain contact with the surveyors throughout the year, through training workshops and other meetings. It was recommended that the co-management Committee stay on the meeting schedules, that the findings are validated with harvest surveyors/hunters regularly, that the cultural respect for the animals are combined with the biological data collection protocols, and that more tools, such as calendars are made use of to track harvest levels. Users can participate in management through focus on local management plans, and develop better methods of harvest monitoring without too much interference in the hunting activities. Users can also be involved in real time monitoring such as using GPS, hiring of local monitors during the hunt, and include high school age students.

Vladimir Yetylin (Russia) *Traditional knowledge of Chukotka indigenous peoples and modern science: Providing mutual reinforcement.* In Chukotka traditional knowledge is available about bowhead and grey whale migration routes. An association of traditional marine mammal hunters was formed in Chukotka in 1997. This organisation represents traditional indigenous users as opposed to commercial users. There are 6 administrative areas and regional branches Chukotka. The organisation has a board, a scientific and a co-ordinating council. It has commissions on whales, walrus, reindeer and polar bear. The Scientific Committee has both scientists and experts on user knowledge. The projects include user knowledge on bowhead migration and grey whale migration, medical knowledge, boat building and mapping indigenous cultural and nutrition needs for whale products (presented at Shimonoseki IWC54). The polar bear Commission is a joint project with the Alaska

Nanuuq Commission. This Commission documents user knowledge on polar bear ecology and cultural needs, using the Alaskan methodology. There is also a monitoring programme for walrus hunting to get real harvest statistics. The walrus appears to show a problems in the population, such as large proportion of sick walrus. It could be that the significant numbers of travellers and tourists are disturbing resting walrus and causing stress related problems. The aboriginal peoples of Russia are represented in the Russian IWC delegation. This has been beneficial for the aboriginal catch quotas. It is a problem for Chukotka that the IWC has turned into an anti-whaling Commission. In managing aboriginal whaling there is consensus on: no voting on aboriginal quotas, aboriginal hunters should have the right to sell products they don't consume and handicrafts. The aboriginal people of Chukotka have expressed interest in working with NAMMCO, which can be done without asking permission from the government. There is also interest among the peoples of Chuktoka to urge the Russian Federation to consider joining NAMMCO.

Dr Borodin (Russia) pointed out that there should be mutual understanding between the parties. In working on a document on aboriginal traditional and cultural needs, involving interviews with hunters it was found that the hunters felt a lack of confidence in the managers. Many hunters have gone back to traditional whaling techniques, and humane killing methods issues are being addressed. Aboriginal people of Russia have serious problems with the IWC, and small should be under NAMMCO. There is conflict with industrial fisheries with respect to beluga, and also with killer whales which follow halibut vessels. Fisheries are managed regionally in Russia. The fishery councils and the research institutes give advice on quotas, which subsequently are approved by the Ministry and subject to environmental assessments. The government does the quota allocations. Marine mammals are managed under the Ministry of Natural Resources.

Session 3 User Knowledge Chair: Søren Stach Nielsen (Greenland)
Key Topics: How the knowledge is gathered, kept and transmitted. What type of knowledge is gathered, the time depth, and for what purpose? What are the weaknesses of this type of knowledge?
Speakers
Meeka Mike (Canada) *Inuit Qaujimajatuqagit Inuit knowledge in Nunavut*. Max Kotokak Sr. (Canada) *User knowledge and the Joint Secretariat, Fisheries Joint Management - Inuvialuit Renewable Resources Committee, Northwest Territories*
Kalle Mølgård (Greenland) *User knowledge in Greenland* Nils Jørgen Nilsen (Norway) *Whaling and fishing: Experiences from Norwegian waters.* Jústines Olsen (Faroe Islands) *How user knowledge is gathered, kept and transmitted among pilot whale hunters in the Faroe Island*s

Meeka Mike (Canada) *Inuit Qaujimajatuqangit Inuit knowledge in Nunavut*. Inuit Qaujimajatuqangit IQ (Inuit knowledge) is the foundation for wildlife management in Nunavut. This is knowledge that people have gained through experience over many centuries, and that is still in use today in hunting and wildlife management practises. The Nunavut Wildlife Management Board is a co-management body established in 1993 by the *Nunavut Land Claim Agreement*, and is the main instrument of wildlife

management. In the period between 1995 and 2000 the NWMB carried out a study of bowhead whales in Nunavut. The study was mandated under the Land Claim Agreement. Elders and hunters were key contributors to the Study through 257 audio and videotaped interviews conducted in 18 communities. In addition, 8 workshops were held in communities with extensive knowledge of bowhead whales. The study focussed in the history of whaling, their seasonal distribution, trends in abundance, ecology and behaviour of bowhead whales, as well as the cultural importance of these whales to Inuit. IQ is a successful knowledge system because it has been in existence for thousands of years. It is therefore not appropriate to talk about IQ in terms of weaknesses. The majority of research and management is based on scientific knowledge. The result is that he bulk of published reports on wildlife is based on scientific knowledge and not IQ. The primary problem is that IQ does not receive enough funds to undertake studies about wildlife. The NWMB is looking to increase the amount of traditional knowledge in its work.

Max Kotokak Sr. (Canada) *User knowledge and the Joint Secretariat, Fisheries Joint Management - Inuvialuit Renewable Resources Committee, Northwest Territories.* There are 5 co-management boards in the region with an equal representation from the Inuvialuit and the government. Respected elders are included. The Fisheries Joint Management Committee has sponsored 3 studies on bowhead, beluga and broad whitefish. The government requires that user knowledge be used in Environmental Impact Assessments. The land selection process involved extensive interviews. The work undertaken is a joint effort between scientists, users (elders and hunters) and government representatives. Today aerial surveys confirm the population of beluga at 120,000 in the region. The Inuvialuit catches about 200 beluga per year, which is sufficient to meet the needs of the Inuvialuit.

Kalle Mølgård (Greenland) *User knowledge in Greenland*. In Greenland, the sea, ice and land are places were people hunt and are a source of physical and inner strength for the hunter, and a link to emotions. The understanding a hunter has about the environment he has received from the culture that he has inherited. This is evident in place names: *Natsilik:* the Place Where the Seal Roam, *Tuttulissuaq*: the Place of Abundant Caribou, etc. The way of life of the hunter and his family is very different from that of people living in industrialised countries. Hunters and nature are tied together with strong ties and the hunter is part of Nature. Nature is neither an object to be conquered nor one that should be made into a national park or museum. Nature is the core of life, and its resources should be used wisely and with restraint. The knowledge the hunter holds is passed on and gained through experience. This is knowledge about animal behaviour, abundance, migratory patterns, their seasonal variations in time and place, and where they aggregate. Without this knowledge it is not possible to survive on the land. The weakness of user knowledge is the lack of distribution of the knowledge. So far some small attempts have been made to collect the knowledge through interviews. The user knowledge should be documented better because it is critical for the management process. The hunters and the managers currently communicate through hearing processes. There is no other forum for exchange and there is a lack of trust between hunters, the government and the biologists. Trust and respect are fundamentals in the process.

Nils Jørgen Nilsen (Norway) *Whaling and fishing: Experiences from Norwegian waters*. In his personal account the minke whaler/fisherman from Røst in the Lofoten Islands explained that he has whaled for a couple of decades and is the second generation of whalers. There are 5 whaling vessels in his town. The Norwegian whalers have observed that the minke whales are migrating past where they used to stop to feed. When there is more herring there are more whales. The whalers and fishermen often see resources where the scientists see little, and this is because the whalers live more closely to the natural environment. The scientists seem to have a large margin for error with respect to abundance estimates. The whalers feel, however, that the current quota of minke whales is sufficient for the number of active boats. The whalers continuously exchange information and learn from each other about where whales have been observed, how they are migrating and what they eat. Their knowledge is also accumulated over the years, and the whalers are getting better and better at what they do. This type of knowledge is not easy to put on paper since it has been learned through experience and the school of life. To recruit more young people to become whalers more people must be trained from when they are very young. They must think of nothing else but whaling. New export opportunities are needed, and people in southern Norway must learn how to eat whale meat. It is also necessary to learn how to better process the meat and the blubber. In the past the quotas were higher, and then the scientists began to estimate abundance and the quotes were reduced. The whalers believed in the numbers collected by the scientists, but when you mix math and politics you get madness. *(Når man blander matematikk og politikk så blir det galskap.)* More recently the minke whale quota has been divided into five zones. It is very difficult for the whalers to catch under such circumstances, and it is weather dependent. The whalers have a reasonable contact with the scientists and are eagerly following their work. Currently Norwegian whalers are looking forward to the new abundance estimates. The management of whales in Norway includes inspectors who monitor the catch. The whalers have no problems with these inspectors who often wonder why they have to watch over the whalers.

Jústines Olsen (Faroe Islands) *How user knowledge is gathered, kept and transmitted among pilot whale hunters in the Faroe Islands.* In the Faroe Islands everyone older than 14 years is considered a hunter and is allowed to participate in the hunt. Today the Faroese catch predominantly long finned pilot whales and other small whales. The catch statistics go back 400 years and the annual average catch of 900 animals is enough to meet the needs of the Faroese and is within sustainable limits. Local knowledge of currents and weather is very important and also knowledge about the geography in the selection of whaling bays. Only certain types of bays are suitable for driving pilot whales. Knowledge about driving techniques and equipment are also critical for a successful hunt. Currently the equipment includes iron gaffs, blunt hooks and whaling knives. After the motor boats replaced the rowing boats in the drives the hunters found that the meat became tougher if the animals were driven too hard. The animals are now typically driven into the whaling bays using the old fashion gentle method. In the past it was a tradition to pass information on pilot whaling between generations, within the families. In modern society, where the family structure has changed, the knowledge is brought forward through the pilot whalers association and government officials responsible for legislation. The whaling foremen hold special

knowledge about weather, currents and tides. Such knowledge is essential for survival in the waters around the Faroe Islands. Today user knowledge includes GPS and other modern equipment combined with the knowledge transmitted through generations.

Session 4 Scientific Knowledge Chair: Mark Nuttall (U.K.)
Key Topics: How the knowledge is gathered, kept and transmitted. What type of knowledge is gathered, the time depth, and for what purpose? What are the weaknesses of this type of knowledge?
Speakers:
Lars Walløe (Norway) *Scientific Knowledge.* Garry Stenson (Canada) *Estimating abundance of seals in the North Atlantic: Designing and conducting a scientific assessment.*

Lars Walløe (Norway) *Scientific Knowledge.* According to Plato knowledge is true opinion combined with reason. It is not enough to just believe something. A good reason for believing something is to have observed it. Both user knowledge and scientific knowledge begin with direct observation of a single fact, and observations of regularities in nature. These are called "empirical laws" in science and explain and predict facts not yet known. Scientists are not satisfied with only "empirical laws" but want to understand the interconnections between these laws, through theoretical laws. Such laws contain terms that are not observable (a gravitational field or a molecule). Theoretical laws are first introduced as educated guesses – hypotheses – or several alternative hypotheses to be tested. Scientists usually choose the simplest possible explanation, which is often expressed mathematically (as in physical sciences and more recently biology). This poses a problem when such models are applied to practical problems. For example, when mathematical population models are used to provide input to management decisions on harvesting wild animal populations, and the managers are not aware of the many simplifications and assumptions embedded in the model. Two biological models, which are commonly used in management decision-making, illustrate the strength and weaknesses of science. The mark-recapture model has been used in several whale population estimates using both natural and artificial marks. This model has its strength in that it is very general, well understood, and it is possible to calculate uncertainty. The weaknesses of this model are that it is necessary to know the natural mortality, that behavioural changes occur and that there are gender differences. It is not known what influence the markings have on the individual animal or on the population. It is an invalid assumption that there is a complete mixing of the whales in a population. The Logistic Growth Model assumes exponential growth followed by levelling off to carrying capacity. In this model carrying capacity is assumed to be a constant, and it is also assumed that harvests are taken randomly. These are weaknesses of the model.

With respect to management of minke whales in Norway the most important question has been the number of whales. The scientists have applied a line transect model, and have eventually obtained consensus on methods and numbers, but some assumptions are still problematic. By comparing the line transect estimates with the mark-recapture estimates it was found to be relatively close. In science belief in specific models must be qualified and assumptions and uncertainties must be recognised.

Garry Stenson (Canada) *Estimating abundance of seals in the North Atlantic: Designing and conducting a scientific assessment.* One type of scientific enterprise is estimating abundance of an animal population. Abundance estimates gives an estimate of the current size of a population and allows for determining trends; it allows for an estimate of sustainable harvest levels, and the role of the seals in the North Atlantic ecosystem can be determined. Based a variety of methods, including flipper tags, satellite tracking and DNA analyses it is known that the seals that inhabit this region are part of one population, and that there is little exchange with other populations. Because harp seals cover a large area, spend much of their time in water and the sexes are often separated and the population is widely spread out over a large range it is impractical to count all the animals. However, the pups are concentrated and can be counted, and the total population can be estimated from such a pup count. There are a number of types of human-induced mortality that have to be estimated. Abundance estimates include numbers on total removals from the population. These include number of seals taken by commercial or subsistence hunters, animals that are struck and lost, by-catch, and unreported catches. For each of these the scientists need to know the age structure of the animals. The information about the human-induced mortality comes from harvest data, fishermen reporting bycatch through phone surveys and logbooks. The number of animals struck and lost will vary greatly with the kind of hunt, weather conditions and the seasons. The age structure is determined from counting the growth rings in the seal teeth, the same way trees are age determined. Estimates of mortality due to natural causes are combined with the data on human-induced mortality to estimate the total number of seals removed. Another factor in abundance estimates is the reproductive rates of females. The scientists use a variety of methods for estimating such rates, and the majority of the samples used come from sealers who have been trained to collect and preserve samples. This is an example where scientists and users work together. The reproductive rates must be carefully monitored each year since they can change fairly quickly. The final piece needed for estimates of total abundance is pup production. Such data should be obtained every 4-5 years from surveys of the whelping concentrations. These surveys require a lot of work, including photographic surveys of pup concentrations. The pictures are taken from aeroplanes and analysed in the lab. The number of pups on each photo must be counted, which is not easy because the pups are white against the white ice and snow. In 1999, over 8,000 photos were read by 6 readers, and took almost 1 year to complete. Visual surveys from helicopters are another method to estimate pup production. The observers count all seals pups present within a measured area. The numbers are multiplied to give an estimate of total numbers. The estimates must be adjusted for pups not born at the time of the survey. The estimates from pup production, reproductive rates and removals are put into a population model to estimate the total population. (For example, the last estimate of total population for Norwegian Atlantic harp seals was done in 2000. It came out with a best estimate of 5.2 million harp seals with a range of + or – 1 million seals.) The scientists provide advice based on management guidelines, which in the case of harp seals in Canada is replacement yield (the level of harvest at which the total population size will remain unchanged from one year to the next). The assessment data and information is published and freely available, and is subject to peer review by international scientists and in public meetings. These public fora are important aspects of the scientific

enterprise. The weaknesses of the current assessments of harp seals are related to the quality of data and adequate sampling, assumptions about constant mortality, that samples are representative and that whelping concentrations are surveyed. Lack of current catch and data and that significant changes may occur before they are recognised are other weaknesses. The strengths lies in the research accounting for the entire population, it is objective, quantitative, predictive and expresses uncertainties in the estimates. The methods used are clearly identified, and standardised, which makes the data comparable over areas and years.

Session 5 User Knowledge and Scientific Knowledge Chair: Einar Lemche (Greenland)
Key Topics: The extent to which users make use of scientific knowledge and the extent to which scientists make use of users knowledge in their studies. Address the co-operation between users and scientists with respect to utilisation of knowledge.
Speakers
Hon. Olayuk Akesuk Minister of Sustainable Development, (Nunavut, Canada) *Inuit Qaujimajatuqangit and scientific knowledge in decision making.* Kalle Mølgaard (Greenland) *The role of scientific knowledge among hunters in Greenland.* Egil Ole Øen (Norway) *Utilisation of user knowledge in development and implementation of hunting gear.* Greg Donovan (U.K.) *Incorporation of user knowledge into management of cetaceans – experience from the development of an Aboriginal Whaling Management Procedure (AWMP) in the International Whaling Commission*
Jóhann Sigurjónsson (Iceland) *User knowledge and scientific knowledge in Iceland*
Dorete Bloch (the Faroe Islands) *Scientific use of user knowledge*

Introductory remark by the Chair: It is not only necessary to acknowledge that user knowledge is important, but also how we will incorporate user knowledge into decision-making process.

Hon. Olayuk Akesuk Minister of Sustainable Development, Nunavut (Canada) *Inuit Qaujimajatuqangit and scientific knowledge in decision making.* The Minister in his presentation noted that the Inuit knowledge and understanding of their land and resources could only benefit from using both types of knowledge systems. Both Inuit knowledge and scientific knowledge are accumulated knowledge that has evolved with new information becoming available to the users over the years, decades and centuries. There are however, differences in the methodology. Inuit Qaujimajatuqangit (knowledge) (IQ) are based on oral tradition and experience, and reflects the past, present and the future. Inuit have always used knowledge gained from the past as a baseline to measure present circumstances and how they will affect future generations. Each generation fine-tunes the accumulated knowledge gained from the previous generation to make it relevant for the present. Therefore, IQ is evolving all the time. Inuit knowledge has made it possible for Inuit to survive in the Arctic climate and co-exist with the wildlife for 1000s of years. Inuit consider themselves responsible when it comes to managing the wildlife, as they rely on these animals for survival. Conflicts are often experienced between wildlife management and wildlife research on the one hand and Nunavut harvesters on the other. These conflicts are due to differences between the Inuit and scientists with a western perspective. There is lack of trust and

lack of understanding between the two groups, which creates barriers for co-operation. Both sides need to learn more about each other in order to work in harmony towards a common goal. The Nunavut Land Claims Agreement recognises the importance of Inuit (85% of Nunavut population) controlling their own affairs. The Nunavut Wildlife Management Board is the main instrument of wildlife management, and the Inuit also have a voice through regional wildlife and hunters and trappers organisations. The Nunavut government is committed to using IQ in the way the government functions, for example through establishing a Working Group in the Department of Sustainable Development to find ways to implement IQ into the Department. There are strong opposing viewpoints between the scientists and the Inuit with regard to the polar bear population size. In the 1950s harvest of polar bear cubs was prohibited, without consulting with the Inuit themselves. If science is to play a vital role in establishing good polar bear management, the use of IQ will have to be increased. IQ can provide the guidance and experience in how to interpret and implement scientific data, and the methods by which the data is collected. The challenge is to reconcile and make maximum use of two knowledge systems. Sustainable quotas are a necessity, the problem remains on how to set sustainable quotas that accurately reflect IQ. IQ is often in agreement with science, and by engaging both systems we will become richer in knowledge about our land and our resources. One type of knowledge does not preclude the other. IQ will be fully recognised and incorporated into the new Wildlife Act of Nunavut. The application of good science coupled with Inuit Qaujimajatuqangit will result in a stronger, more effective management regime that will benefit both the wildlife and people of Nunavut.

Kalle Mølgård (Greenland) *The role of scientific knowledge among hunters in Greenland*. Before the Greenland Home Rule was introduced there was more collaboration between scientists and the hunters. The biologists used to work closely with the community and the hunters on different species. Upon arriving in a village, the first thing the biologists would do would be to visit and consult with the hunters about information on different species. This is no longer the case. The biologists come from industrialised society educated in thinking about and managing nature very differently from how the Greenlandic people are familiar with. In the eyes of the animal rights movement and others, the Arctic – our home – has become a marginal society, a place that has not yet been reached by pollution, not yet ruined by greed. These people are of the opinion that the Arctic environment, including the fauna, should be preserved and protected. Biologists with such backgrounds have become government consultants. Because of the different backgrounds and because of the lack of co-ordination between these two types of knowledge, conflicts arise. There are no fora where the users can share information about the resources and their environment. There is currently no mechanism for the government or the biologists to gather and utilise the experience that has been accumulated by hunters in the different regions and through the different ways of life. The knowledge is very local in nature and such an undertaking is major and would require resources in terms of time and money. There are some efforts to establish a database that will combine the knowledge of hunters and biologists, but this will change nothing as long as management is heavily centralised, and there is limited communication between the users and the government.

Egil Ole Øen (Norway) *Utilisation of user knowledge in development and implementation of hunting gear*. There is no strict borderline between user and scientific knowledge, but the parties often acquire their knowledge from different sources. The scientific knowledge is more specific in nature and can be utilised in many areas. User knowledge tends to be broader and based on, and influenced by earlier experiences. User knowledge is also transferred between individuals, and carries a wealth of details. It is not necessarily true that user knowledge is always correct, which is an important factor to recognise. It is important for scientists to recognise that their conclusions will have consequences for the users. In many cases the scientists have the benefit of being outsiders, without economic interests in the results. Co-operation between users and scientists is critical in developing new hunting methods and techniques, and the scientists should take the initiative. Hunters' organisations usually provide a forum for co-operation; otherwise the interested parties must form their own forum. Co-operation between scientists and individuals can also be fruitful. The co-operation should start as early in the process as possible with consultations even before setting the agenda. This is beneficial to both the scientists and the users. It is, however, important that the formalisation of co-operation does not hinder the scientific integrity. This means that the scientists must carefully evaluate the messages from the users. At the same time the scientific information must be brought back and evaluated in the communities. The expectations from a project may vary between users and scientists, and this must be transparent, Honesty is also important when knowledge is exchanged and shared. When communication is lacking it may be necessary to halt the co-operation. It is important that the scientists get practical experience by going on hunting trips. Users are more likely to become engaged if the scientist is well informed and skilled. This builds trust between the parties. Research results may be interpreted in different ways. The users, in particular respected elder hunters, should be consulted about the interpretations and it is critical that such interpretations are discussed in open public fora. There is always a chance that interpretations are motivated by self-interest. Scientists must be free of professional tunnel vision and each party must trust the motives of the others. It is recommended that scientists work closely with the users in all respects.

Greg Donovan (U.K.) *Incorporation of user knowledge into management of cetaceans – experience from the development of an Aboriginal Whaling Management Procedure (AWMP) in the International Whaling Commission.* There is no formal definition of "aboriginal subsistence" whaling. It has "traditionally" been accepted for Greenland, Alaska, Washington State, Chukotka, Siberia and St Vincent and the Grenadines. Since its inception the IWC has treated "aboriginal subsistence" (AS) whaling and commercial whaling differently from a management perspective. There is no formal definition that distinguishes AS from small-type whaling, such as Norwegian whaling. In a management procedure, versus an ad hoc management, 1) the objectives are explicitly stated and have assigned priorities; 2) data and analysis are realistic and specified; 3) accept limitations and take the inevitable uncertainty explicitly into account; 4) rigorous testing through simulations; 5) include feedback monitoring. It is important that the scientists are not arrogant about their data. The advantages of such procedure to the users are that 1) the objectives are known; 2) the data requirements and treatment are specified; 3) it removes the ad hoc nature; 4) the

catches are stable. Creating a management procedure is an iterative process, where the users participate in setting the goals. Scientists do not participate in this stage, since the scientists should not be involved in setting the goals. Both scientists and users are involved in determining whether the data are available and obtainable. The scientists develop the procedures, while the users and managers develop the design features. The scientists recommend the choice for management but the managers choose the management options. The primary objective of the management procedure is to ensure low risk of extinction. The other objectives include enable harvest in perpetuity appropriate to cultural and nutritional needs and maintain stocks at healthy levels. The procedure must be based on best available data, and must embrace uncertainty in a reasonable way. Data on stock identity and stock status require user in put regarding the timing of the surveys and the distribution of the animals. Users can also be observers on the surveys. There must be a partnership build on mutual trust throughout the process. The personalities of the parties involved are also important. All parties must be prepared to accept the outcome of the assessments. The user input via management objectives, science (in terms of survey design, and personnel) and in shaping the design criteria. Such studies are costly, (the Alaska bowhead study, for example, cost millions of dollars, and it may be necessary with international funding.

Jóhann Sigurjónsson (Iceland) *User knowledge and scientific knowledge in Iceland.* Currently science-based management of fisheries and other resources is the only choice available. However, a dialogue between resource scientists and the users is unquestionably necessary. We are not dealing with two conflicting elements but rather complementary ones. The question is how useful the fishermen's knowledge is to the scientists. Scientists formulate hypotheses, collect data, analyse and interpret the data and draw conclusions. The users draw conclusions from past experiences, traditional knowledge, the society of which they are members, and personal experiences. Each type of knowledge has its problems or limitations. Scientists lack real time observations may use inappropriate parameters or methods, the scope of the study may be too limited and more research effort is often needed to draw firm conclusions. The users lack the total view, may have biased view based on personal interests, short-term memory and an inaccurate documentation of the past. The users' knowledge is a valuable source of information, but it does not constitute an alternative to quantitative scientific studies. To be competent a fishery scientist must experience fishery or hunting activities. In one study hypotheses was generated based on interviews with users, studies of logbooks, station records and modelling. In addition the whalers can provide guidance in the interpretation of the results. The fisherman's knowledge can be incorporated into the scientific process through an *a priori* exploration of traditional knowledge, through interviews, questionnaires, and learning by participation in the fishing operation. It also necessary to have communications at all levels throughout the year, through meetings, mass media, specified fora and expert (fishermen and scientists) task forces, and direct involvement with the fishermen. Currently the Icelandic task forces of experts communicate with each other about the resource situation, recent developments, plan and co-ordinate data collection and co-operation. For example, the Icelandic fishermen are directly involved in the design and in conducting the Icelandic bottom trawl survey. There has to be a common understanding of the research objectives and management principles, a common

interpretation of the results, and a development of a common terminology. Fishermen's knowledge is essential in developing scientific resource studies but not a substitute. Incorporating fishermen's knowledge involves exploration of traditional knowledge, scientist participation in hunting activities and constant communication.

Dorete Bloch presented by Bjarni Mikkelsen (the Faroe Islands) *Scientific use of user knowledge*. In the Faroe Islands user knowledge has been utilised in many aspect of the pilot whale drives such as to identify the proper beaches. Based on this knowledge 23 beaches have been authorised as whaling bays. The development of the equipment used in the pilot whale drive has also been based on user knowledge. For example, it has been found that the ancient custom of throwing stones into the water was not to scare the whales but to interfere with their sonar, through the bubbles created by the stones. The tradition of measuring shares of the catch is also based on user knowledge. People who were not pleased with the size of their share developed a rod for measuring the eatable part of the whale. The wooden rod is logarithmically divided so that the length is linear with the weight of the eatable parts. Another aspect of the user knowledge the "pilot-whaling-weather", which indicates the influence of weather on pilot whale drives. After comparing such weather with meteorological data it was found to be a correlation between the pilot whaling weather and the observations of pilot whale pods.

Session 6 Discussion: Panellists and Open Meeting Chair: Mark Nuttall (U.K.)
Key Topics for Discussion: The differences, similarities, strength and weaknesses of user knowledge and scientific knowledge.
Panellists: Amalie Jessen (Greenland); Garry Stenson (Canada); Lars Walløe (Norway); Hans Jacob Hermansen (the Faroe Islands); Charlie Johnson (Alaska, USA) and Milton Freeman (Canada)

The panellists gave some introductory remarks before it was opened for a general discussion.

Amalie Jessen (Greenland) compared the strengths and weaknesses of the two knowledge systems. The strengths of user knowledge can be summarised by the following: Hunters are present in the area year round; it is holistic, intuitive and specialised. The strength of scientific knowledge is that it can be organised in models and boxes, it is possible to document, and is analytical and specialised. The weaknesses of user knowledge is when the knowledge may differ between the hunters, and when the transmission is limited. It is also difficult to collect user knowledge. The weaknesses of scientific knowledge pertains to the limited time spend in an area and that the survey methods differ between species. The opportunities exist for improving the dialogue and co-operation, which will give a better basis for decisions.
Garry Stenson (Canada) These are both forms of knowledge with good and bad aspects. In many ways the two are not so different. The difference pertains to the objectives and scale at which they operate. User knowledge tends to be local and scientific knowledge tends to be general. The context in which the knowledge is reviewed and transmitted is a bit different, but both worry about the lack of

understanding. It is easier to understand each other if it is understood what the objectives are for the sciences or for the users.

Lars Walløe (Norway) It is important to distinguish between user knowledge and user beliefs. Are confirmatory investigations of user knowledge required? Both forms of knowledge can be misleading, and both sides have vested interests. It is therefore important to be sceptical to both kinds of knowledge.

Hans Jacob Hermansen (Faroe Islands) Knowledge is easy to carry. One has to ask what is the motive when using the knowledge, who is asking and for what? Political decisions are often the result of vested interests. It is important that there is good communication between scientists and users, to ensure co-operation, dialogue, trust and respect. There is generally no problem if there is no conservation issue.

Charlie Johnson (U.S.A.) User knowledge is about cultural survival, but forms of knowledge can coexist. Our forefathers knew distributional relationships between animals, which is something the scientists will have to consider. The use of co-management agreements allows users an equal say in research priorities and management. It is an issue of power relationships.

Milton Freeman (Canada) One of the issues is that scientists share a common culture, but users do not. Users, or indigenous peoples, are a diverse group, and there is a large literature on TEK or indigenous knowledge. The term indigenous knowledge may not be applicable to a Norwegian fisherman, because indigenous knowledge is directed by sacred relationships to the animals and spiritual aspect. This is not easily understood or described, and have management implication, because scientists do not often recognise this in discussions of resource use. Indigenous peoples are profoundly ecological in nature. For example, peoples in the north have a very sophisticated system for describing of sea ice, which is based on an understanding of the processes involved. Indigenous knowledge is able to incorporate the complexities of nature. Science continues to cling to single species approaches. Indigenous knowledge is more comprehensive than science and hence a vulnerable system, and writing it down leads to de-contextualisation. The vitality is lost in the transcription, because it is learned by doing not by reading. It is important that it continues to be practised, and that uneconomic hunts are maintained so skills and knowledge are not lost. Cultural survival is at stake.

General Discussion

The following is a summary of the discussion that followed the first set of sessions.

There is a danger that knowledge becomes de-contextualised through science, because scientific knowledge does not transfer the emotional aspects of knowledge. Scientific knowledge is also subject to a thorough review process. Is it necessarily true that indigenous people are natural ecologists? There is also the chance that user knowledge becomes over romanticised, e.g. Maori over harvesting leading to bird extinction in New Zealand, and similar changes could possibly occur when harvesting equipment changes. A counter argument is that indigenous use is a complex system of harvesting that is often opportunistic, and is based on need. Animals also play an important role in indigenous cultures. All information must be seen in its proper context. When needs are rising, takes will be rising and as such the culture will not prevent overexploitation.

It is not the distinction between commercial and non-commercial use of marine mammals, which distinguishes indigenous from non-indigenous harvesting. Commercialised use of marine mammals does not occur in Canada and Alaska but does in other areas. Aboriginal whaling has been placed in a non-commercial box by the IWC. Is it possible to incorporate user knowledge in a purely commercial operation?

Some thought that there are more similarities than differences between the two harvesting systems. It is not whether the products are sold in the market or not which should distinguish the systems. Today money is necessary in all cultures. Some raised the question of whether science is compatible with Inuit lifestyle? One hunter considered the butchering of seals a science, and noted that Inuit also take conservation measures. This is particularly important when the hunt is based on need. Other indigenous people argued that it is necessary to focus on the management implications of the need based hunting, and apply this to the utilisation of the resources, which is in constant change. The sacred relationship between people and animals must be considered more in resource management. Sometimes the indigenous groups take the best from both worlds and sometimes the worst. Some scientists noted that it is not impossible that indigenous management could or has lead to overexploitation. It is important to study these management regimes in detail. At some level is clear that user knowledge is romanticised: all fishermen are right and science is wrong. There is never a question that user knowledge is wrong. In some cultures you must believe respected elders, but scientists never believe anyone. Instead science always asks questions, but the only thing that is included in the report is information that is relevant to the scientists, the rest is ignored. For the users their knowledge is part of the totality in life.

In some areas there is a management system in place, but scientists and managers refuse to understand this. This is because the knowledge has to be seen in its context, and that high complexity is difficult to put into words. Scientists and users belong to different cultures. In some user cultures advice and information is sought from respected elder. According to many users, the scientific culture always asks questions, but only include information that is relevant to science in its reports. Science requires reductionism and simplification of a much more complex reality where some of the components in the view of the user are irreducible. For the users their knowledge is holistic and pertains to all aspects of life. Therefore for a user a lot of information has to be included in order to understand and explain the context. This is inherently unsatisfactory to the scientists.

Communication and humility are important ingredients for building confidence and trust between managers, scientists and users. To ensure success in communication both groups will have to accept the limitations of their knowledge.

Some believed that indigenous people would change and become more efficient in their harvesting activities, because profit maximisation is a driver in all cultures. The managers are placed in the middle of the two systems, and must listen to both groups, but what should the managers focus on? The work is a lot more difficult when the two

groups argue and show lack of respect. Some argued that it is important to keep science as separate as possible from special interests. In many ways users can be seen as having special interests. Others noted that users that users should not involved in generating advice, this has to be done at the government level. It is important to distinguish between user involvement and user knowledge, and co-research is different from co-management. In many cases it is found that science and user knowledge are treated as independent sources of information. By some the two were seen as mutually independent streams of knowledge. Some noted that the session had provided guidance for scientists in incorporating user knowledge into science, any good scientist will do this. But such guidance is not necessarily applicable to management.

Session 7 Management Decision-Making Process PART I, Chair: Halvard P. Johansen (Norway)
Key Topics: The information sought in management decisions, and where the information is collected. The process of drafting regulations.
Speakers:
Kaj P. Mortensen (Faroe Islands) *Management and drafting regulations in Faroe Islands.* Kim Mathiasen (Greenland) *Management and drafting regulations in Greenland.* Kolbeinn Árnasson (Iceland) *Management and drafting regulations in Iceland.* Lisbeth Plassa (Norway) *Management and drafting regulations in Norway*

Kaj P. Mortensen (Faroe Islands) *Management and drafting regulations in Faroe Islands*
The whale hunt in the Faroe Islands is regulated by government order, stipulating in detail the requirements for the organisation, supervision and control of the whale drive, killing methods and equipment as well as rules for the distribution of the catch. The regulations are under constant review and update. The Ministry of Fisheries is responsible for the administration of the whale hunt, including drafting of regulations and participation in international bodies, such as NAMMCO. The Ministry also co-operates with the Faroese pilot whalers association, which serves as a forum for public debates and discussions on issues related to the hunt. The Ministry is also responsible for administration of Commercial Fishery Act of 1995. This includes monitoring the system in number of fishing days, and biological and economic sustainability. The Fishing Days Committees, under the Act, is responsible for allocating the number of fishing days per vessel includes user representation. Other committees further scrutinise the scientific advice and make recommendations to the Ministry. The commercial sector and the scientists participate in the review committees. The objectives of the Act are sustainable and rational exploitation, and a maximisation of employment and income.

Kim Mathiasen (Greenland) *Management and drafting regulations in Greenland.* In the Coalition Government Agreement of December 2002, it is stated that traditional knowledge in addition to biological and other scientific research should provide input to management. Resource management is based on sustainable use and protection of the environment. Educational programme focusing on basic principles of sustainable development will be a part of the curriculum. The objective of the Hunting Act is to ensure appropriate and biologically sustainable use. The utilisation must be in

accordance with biological advice and financial and occupational regards. Emphasis shall be based on hunter and user knowledge within relevant organisations and the Council on Hunting. The Council on Hunting was established in 1999, and includes among others KNAPK, Association of Municipalities, Part time fishers and hunters association, the Department of Fisheries, and a number of non-voting members. The process of drafting regulations includes scientific advice from the Greenland Institute of Natural Resources and other advisory bodies consisting of users, hunters, scientists and managers. The advisory bodies have no decision power. The hearing process in which the cabinet pass orders and the draft regulations are submitted to a set of hearing partners. The Council on Hunting provides advice to the government, but the decision-makers do not always take the advice. The agreements are usually reached by consensus, with the possibility for minority statements.

Kolbeinn Árnasson (Iceland) *Management and drafting regulations in Iceland.* The fisheries management system in Iceland is based on the concept of individual transferable quotas (ITQs). Each vessel has been allocated a permanent share that is a percentage of the total allowable catch (TAC) in each species each year. The quotas can change and the ITQs can be transferred. The TAC decisions are taken annually, based on recommendations from Marine Research Institute. Usually the advice is followed, but the Minister is not bound by it. Special catch rules are used for certain species such as cod and capelin where species interactions are taken into account. Although input from users is highly valued in setting the regulations there are no formal channels for such input. Information from users has been the basis for increased quotas in some cases. The interactions occur for the most part at the scientific level, but the interaction between users and the MRI have been developing in a positive way benefiting fisheries management. Other aspects of fisheries management include control and enforcement. Co-operation between the authorities and the management is essential in this regard. Following the Reykjavik Declaration, management practices need to consider the ecosystem as a whole and take into account ecosystem relations, through a balanced use of resources and avoidance of disproportional use. Important work on multi-species modelling is important to active co-operation and balanced resource use. Finding such a balance requires that all available information be used in the resource management.

Lisbeth Plassa (Norway) *Management and drafting regulations in Norway.* In Norway marine mammal management involves whale hunting and seal hunting, both Arctic and coastal. Currently the seal quotas are under-utilised. For drafting regulations information from scientists about stock status and for making decisions on TAC is required. It is also necessary with an evaluation of whether requirements for participation in the whaling or sealing are necessary. Information included in such evaluations is based on history, ownership and registration, and is provided through a dialogue with the whalers and sealers. Information, from users and scientists, is also needed to set technical regulations, which entails shooting skills, hunting courses and training to ensure safety for the hunters and the best killing methods for the animals. The TACs are established based on advice provided by the scientists. The Ministry of Fisheries established an advisory board for marine mammal management in 2001. The Board provides advice to the Ministry on whaling and sealing, based on input from

scientists and users. The membership includes among others, the Norwegian Whalers Union, the Seamen Union and representatives from the scientific community and the industry. The users are heavily represented in the Board. It is hoped that through participation on the Board the users will better understand the reasons for the regulations. The authorities are not required to follow the advice from the Board. The Board provides a dialogue that is essential for effective management, but it is also important to stay in contact through less formal fora.

Session 7 Management Decision-Making Process PART II Chair: Halvard P. Johansen (Norway)
Key Topics: The role and application of user knowledge in management decisions. The role and application of science in management decisions.
Speakers:
Kjellrun Hiis Hauge (Norway*) Different ways of knowing: Problems and possibilities*
Henry Huntington (Alaska) *The challenges of management decisions: A case from the Alaska Eskimo Whaling Commission.* Michelle Wheatley (Nunavut) *Wildlife management in Nunavut: Integrating Inuit Qaujimajatuqangit (Traditional Knowledge) and science*. Amalie Jessen (Greenland) *User knowledge, scientific knowledge and the management decision-making process in Greenland.* Guðríður Margrét Kristjánsdóttir (Iceland) *The management decision-making process in Iceland*

Kjellrun Hiis Hauge (Norway*) Different ways of knowing: Problems and possibilities.* The most fundamental disagreements occur when there are conflicting interests, the knowledge is uncertain, there are different ways of knowing and when there are different concerns. Uncertain knowledge creates room for interpretation. Both user knowledge and scientific knowledge are uncertain when it comes to predicting the future. The characteristics of science are that it is exact, neutral and relevant. The aim of science has been to produce objective knowledge independent of politics, language, or the individual scientist in charge. Quantitative knowledge has been thought to make knowledge transparent and thereby objective. Whereas in the past science dealt with concentrated studies of single phenomena, science today deals with complex issues, which cannot be controlled in a laboratory. Ecosystem studies and global problems are extremely complex, and therefore the science is uncertain. Management under uncertainty is an ethical question, and overstating certainty reduces quality of science. It would be beneficial if people from the outside fisheries science got the opportunity to how scientific methods affect the quality, relevance and neutrality in advice on management questions. It should also be recognised that science is not value free. The information provided should always be as transparent as possible so that outsiders can understand the work behind the data. Social learning refers to a learning process that includes all stakeholder groups and forms a basis for a management decision. The stakeholders are brought together in a constructive discussion to share objectives and experiences. This is way for expert groups to explain their perspective to others with an interest in the same issue (or resource). The notion is that there are issues that are too important for experts to handle alone. The involvement of the stakeholders will ensure that the social aspects are considered. An important aspect of a policy decision process is formulating questions. The questions chosen will determine the answers one gets. Often managers want answers to the

wrong questions. Social learning is a process that can bridge different ways of knowing, including experts like hunters, scientists and managers.

Henry Huntington (Alaska) *The challenges of management decisions: A case from the Alaska Eskimo Whaling Commission.* The tale of the Cook Inlet beluga is a cautionary tale. The Cook Inlet beluga is a distinct stock near Anchorage. It has been suspected that the rapid and recent decline of the beluga population is a result of over harvesting for commercial purposes. When some hunters sold products from the Cook Inlet beluga they were kicked out of the beluga Commission. This has caused a conflict among peoples hunting beluga, leading to disparate user groups. The abundance estimates of the beluga were difficult and not believed by the users, because they were not easily explained. Some claimed that this was a small component of a larger stock. Some held that over-fishing, pollution, runoff and sewage could potentially have influenced the stock size. Others wanted the stock listed as depleted so harvest and environment restrictions could be put in place. During this process there was some co-operation from the hunters as they assisted in satellite tagging and participated in the surveys. Traditional ecological knowledge was used in the process. In the end it took a special act of congress to allow quota with co-management.

Michelle Wheatley (Nunavut) *Wildlife management in Nunavut: Integrating Inuit Qaujimajatuqangit (Traditional Knowledge) and science*. The Nunavut Wildlife Management Board (NWMB) is the main instrument of wildlife management in Nunavut. It is a co-management board, where Inuit appoint half of the members and the government appoints the other half. It is a public government institution, in which the decisions are subject to the ultimate authority of the Minister. The principles of wildlife management recognise the Inuit systems of management and that there must be an effective role for the Inuit in the management process. The principles of conservation include ensuring the natural balance of ecological systems, protection of wildlife habitat, and maintenance of vital, healthy, wildlife populations capable of sustaining harvesting needs. Management decision of the NWMB relies on the best available knowledge, scientific or Inuit knowledge (IQ), and focus on subsistence species (e.g. narwhal, bowhead, polar bears). Integration of IQ is ensured through Inuit membership in species working groups, public consultations, publication of research results, and priorities workshops. (The NWMB has developed a management plan for the North Hudson Bay narwhal. The bowhead knowledge study completed.) The NWMB and the co-management partners seek greater use of IQ in decision-making. To be of most value, IQ must be properly documented, be collected in a systematic way, use an eco-system approach and document relationships within the environment. As more traditional knowledge is documented, its role in wildlife management in Nunavut will expand accordingly.

Amalie Jessen (Greenland) *User knowledge, scientific knowledge and the management decision-making process in Greenland.* User knowledge in Greenland have existed ever since the country got inhabitants, and people live off of and survived by using the living resources. Scientific knowledge was introduced more or less when the missionary Hans Egede came to Greenland in 1721, but the first formal research

started in 1908 and 1909. In 1994 the Greenland Institute of Natural Resources housing facilities were established in Nuuk after having been housed in Denmark for many years. A new era started in Greenland. Currently the department of fisheries, hunting and agriculture is the management body for marine mammals in Greenland. Today most people in Greenland live in towns, with an increased industrialisation. This has changed the nature of user knowledge. There are two streams of advice for managers from biologists and from the users. The biological advice comes form different sources depending on the species; IWC give advice on large whales, NAMMCO, NAFO/ICES and Canada-Greenland bilateral relations on seals and small whales. A large proportion of the input comes from the users in the form of hearing, information meetings and through the regulatory process.

Guðríður Margrét Kristjánsdóttir (Iceland) *The management decision-making process in Iceland.* User knowledge is important in Iceland, and linking it with scientific knowledge is the only way to ensure sustainable resource use. It is therefore important to link collected data available to scientists. The Marine Research Institute undertakes a systematic assessment of marine resources and has an advisory role for the management of fisheries, including recommendation to the Minister. These recommendations are not binding. Information from fishers can be taken into account but this happens only rarely, and there is no formal process for this involvement. The data used by the scientists are collected in three ways: systematically from the landed catch, by the IMR research vessels and in the ground fish surveys. The fishing vessel logbooks are an important source of information with detailed information on fishing practices such as locations, dates, gear and catch quantity. This is an important way user knowledge is made available to the scientists. There are also technical measures, such as area closure and prohibition on the use of fishing gear. The fleet structure is also regulated according to size, sub areas and seasons, and an old rule that divide fishing areas according to the fishing gear. A new provision has been introduced in the Fisheries Act of 1997. The IMR has the right to temporarily close a fishing area when at least three captains report of excess of juvenile fish in their catch, measured in a way the IMR has agreed upon. This provision was introduced as a result of the users declaring themselves willing to make an effort in ensuring sustainable utilisation of fish stocks. In ensuring sustainable utilisation of our marine living resources it is important to find a way to intertwine user knowledge with science.

Session 8 Discussion: Panellists and Open Meeting, Chair: Milton Freeman (Canada)
Key Topics for Discussion: Are there ways to improve how user knowledge and scientific knowledge are incorporated in management decisions. Can the two knowledge systems play complementary roles in management decisions?
Panellists
Henry Huntington (Alaska), Julia Green (Australia), Monica Riedel (USA), Vladimir Yetilyn (Russia), Einar Lemche, Søren Stach Nielsen (Greenland)

Milton Freeman suggested that NAMMCO organise a conference on management regimes, and take a broad and holistic approach to the management.

Julia Green (Australia) Dr Green noted that it is easy to take decisions if there are no domestic costs (e.g. southern ocean whale sanctuary). The opposite is true in the Arctic, where decisions about the environment are more difficult and complex. In the toothfish management in CCAMLR it has been claimed that the catches were taken north of the boundary. The original boundary was based on the Antarctic Convergence, and it is possible that the fish has moved north since the boundary was drawn. In CCAMLR decisions are taken by consensus, however, some of the IUU vessels belonged to the member states and the fishermen would not co-operate because the fishers did not have a stake in the process. It turned out that everyone had a different interest in the process, the fishers, the IUU, the conservationists and CCAMLR. There was no will to find a common ground.

Monica Reidel (USA) How can this discussion be applied to Alaska? In Alaska there is a good structure in place that needs implementation. This requires participation in the process from all involved parties, users, managers, and scientists. The scientists need to understand the spiritual relationships of hunters to the resources. The hunter's knowledge has a basis in spiritual connections, and this must be recognised and respected. Killing animals, distributing the meat and other products, these are traditions and not romanticism.

Søren Stach Nilssen (Greenland) Dialogue is the main requirement for success. It would also be helpful with more examples of management, which involves both types of knowledge from other areas. How do the users feel about the discussions on this topic?

Einar Lemche No universal rules can be extracted from the presentations and discussions, but the experiences can be brought back home and used. It is important not to loose momentum after this conference. NAMMCO can agree to keep this issue open. It is also important to take note of the places and organisations where successful incorporation has taken place. It is necessary to have an organised forum for exchange, discussions and information. NAMMCO could become a knowledge bank for such a forum. The main areas could be: 1) How to compile user knowledge. How to ask the right questions and document as is. How can the story be told that includes the complexities to the satisfaction of the users? Perhaps this is a two-phased process, transcription followed by synthesis. When feeding the managers the information should they be fed scientific knowledge and user knowledge independently or should they be merged? 2) A compilation of success stories, and 3) Hunters should participate in the planning and the conduct of western science. How can this be accomplished?

Open Discussion

The notion of integration may suggest a sameness that may not be there. There may be linguistic barriers even to integration. The term used by NAMMCO has referred to how user knowledge can be incorporated into management. There is a difference between incorporating user knowledge into the management decision-making process and integrating user knowledge into science.

The discussion that followed centred on whether the two knowledge systems could be integrated, and their differences and similarities. Some argued that user knowledge could not be, or should not be integrated into science, but instead that both should be equally respected. It cannot be expected that we have a universally comprehensive

system; instead the work must be done locally. Others thought that it was obvious that user knowledge should be incorporated at two stages, first as valuable input to the scientific process, and secondly be entered directly into the decision making process regarding hunting procedures and regulations etc. In the IWC for example scientific results are presented, and it is necessary to use scientific arguments and language to convince the world. User knowledge could be presented in concert not separately from western science. Some thought that science would always take precedence because of funding and education. Some scientists have tried to incorporate user knowledge in their work, and have found that the goal must be to come up with some results. It is essential to present the results of the research. The incorporation of user knowledge in the research will have to be restricted to smaller advisory groups or it will never end.
Incorporating user knowledge into science does not change science. On the other hand science may have nothing to offer user knowledge in terms of spiritual values, and scientists have a much narrower view on the usefulness of user knowledge. It has been found that scientists do not recognise parts of information that is not useful for them. Hunters have often been brought to scientific meetings where the scientists have expected results. This can only be achieved if the scientists know what they want and that there is dialogue and clear objectives. Research proposals reflect many different perspectives. It seems that there are two different information streams, without possibility for integration between them. Science is often given more weight in the management process, but the results are often not reported back to the local level. User knowledge offers a rich resource for management. The power relations between user knowledge and scientific knowledge are based on differential access to funding, and access to the managers. The process of dialogue is often handled through meetings, which may not be an appropriate forum. The differential power relations may be partially solved if the researchers initiate co-operation and involve knowledgeable hunters, selected among them, at the design stage of the process. In this process there have to be an honest sharing of knowledge. Is it possible that this would lead to commonly accepted results? Others thought that it would be convenient to merge the two forms of knowledge, but when the objectives are different this is difficult. There was general agreement that more focus is needed on the management objectives. This has to be accepted by the managers. Some of the hunters noted that they were open to work with experts, and increase the demands on the hunters. It is easier to criticise the scientists if there is no co-operation. The communication between the two “groups” is important. To ensure success in communication both groups will have to accept the limitations of their knowledge. One issue is the problems of terminology and language. It was noted that it would be useful to build capacity to gather user knowledge, and create current and accessible databases. The information, once interpreted for the databases, must be confirmed with the participants to avoid that the meaning is lost in the interpretations because hunters and scientists may interpret the same data differently.

Session 9 Conclusions Chair: Grete Hovelsrud-Broda (NAMMCO)

Halvard P. Johansen It became clear from the conference that there were a number of common issues and problems, and that there is much to learn from each other’s experiences. The Conference has also illustrated clearly that this should not be one

time event, but should remain on the agenda of NAMMCO. Through this topic closer co-operation can be developed between NAMMCO and other countries.

A number of common themes emerged from the presentations and discussions. The ad hoc drafting group prepared the following list:

Common Themes (not exhaustive)

- There is a need for involvement by the users in both scientific projects and in the management decision-making process. This involvement should be formal and maintained throughout the process starting with the design of the projects.
- There is a need for documenting the availability of user knowledge, its characteristics and how it works.
- Continuity and accountability are important to build trust between the parties. The concept of social learning was introduced as a methodology for achieving this.
- A significant investment of time, effort and money is necessary for the process to go forward. There are no simple, short-term solutions.
- All parties must show humility, and recognise the fallibility and limitations of both forms.
- Show a strong commitment to agreed-upon common goals and objectives.

Recommendations

An analysis of successful examples of incorporation of user knowledge in science and management should be undertaken. This could be compiled by NAMMCO in a book to serve as a valuable resource for NAMMCO member countries and others;

Specific advice should be given for specific cases, so that the advice is tailored to the local context of the management problem.

It is recommended that NAMMCO create an ad hoc committee to ensure the continuation of this work. This committee should also follow-up on the recommendations and developments in different areas. It would be helpful if others report to NAMMCO, and that the committee include people outside of NAMMCO member countries;

It is recommended that dedicated forums (such as the Alaska Eskimo Whaling Commission or the Nunavut Wildlife Management Board) are created and supported. The process of incorporating user knowledge in the management decision-making process cannot be ad hoc.

It is recommended that management decisions are made transparent and that they are explained. The reasons for the decisions must be explained, such as why certain information was rejected.

It is recommended to build capacity among users for all aspects of user involvement. It is important for the success of involving the users that they are allowed to speak for themselves.

It is recommended that relevant organisations strive for achievable steps to keep making progress. This can only be ensured through open communication and dialogue.

SECTION 2 - MANAGEMENT COMMITTEE

2.1
REPORT OF THE MANAGEMENT COMMITTEE
Leangkollen, Norway 5 - 6 March 2003

1. - 3. OPENING PROCEDURES

The Chair of the Management Committee, Kaj P. Mortensen, welcomed delegations and observers to the meeting. Participants to the meeting are listed in Section 5.1. The agenda, as contained in Appendix 1, was adopted. Documents available to the meeting are listed in Appendix 2. Daniel Pike was appointed as rapporteur for the meeting.

4. NATIONAL PROGRESS REPORTS

National Progress Reports for the year 2001 were available from the Faroe Islands, Greenland, Iceland and Norway. The Secretary noted that Canada and the Russian Federation had been invited to forward summaries of relevant marine mammal research to NAMMCO in conjunction with their invitations to attend the 10th Meeting of the Scientific Committee as observers. No progress reports had been forthcoming as a result of these requests. The Secretariat will in the future also forward separate invitations to Canada and the Russian Federation to present such data to NAMMCO, as was decided by the Management Committee in 1998.

The Observer for Canada presented information on a multi-year management plan for the Atlantic seal hunt, which was announced in February 2003. For harp seals total allowable catch is set at 975,000 over a 3-year period. If the full quota were taken and Greenlandic harvests were as forecast, the total take should result in a slight population reduction over the period, while still maintaining the population well above the conservation reference points adopted. For hooded seals the TAC will remain at 10,000 per year, with no take of bluebacks permitted.

Greenland noted that the stocks of harp and hooded seals were harvested in both Canada and Greenland. However the new management measures had not been discussed bilaterally between Canada and Greenland before they were adopted. Greenland found this unsatisfactory and asked the Observer for Canada to convey this message to the Canadian Government.

Norway emphasised its continued interest in obtaining genetic samples from minke whales from all areas of the North Atlantic, in order to improve the information on the stock delineation of this species, and urged that such samples be collected both on an opportunistic basis and by directed programs.

5. STATUS OF PAST PROPOSALS FOR CONSERVATION AND MANAGEMENT

The Committee considered document NAMMCO/12/MC/3 (Appendix 3) which was a record of past proposals for conservation and management put forward by the

Management Committee. The Chair asked the Committee to comment on any regulatory or other measures that had been taken in response to these proposals.

5.1 Atlantic walrus

In 1995 the Management Committee recommended that Greenland take appropriate steps to arrest the decline of walrus along its west coast, and encouraged Canada to consider working co-operatively with Greenland to assist in achieving this objective. Greenland informed the Committee that the regulatory initiative to introduce quotas and other hunting regulations for this species had been delayed, and comprehensive public hearings have been conducted. The draft regulations have now been submitted to the Council of Hunters. It is expected that a final decision on the initiative will be taken later this year.

5.2 Ringed seal

Greenland noted the past conclusion of the Management Committee that the harvest of ringed seals in West Greenland waters is sustainable. The Greenland government is instituting a regulatory system whereby quotas could be introduced if required, but they are not considered necessary at this time.

Greenland provided further information on the increased incidence of hairless and partially hairless seals in Greenlandic waters. This has been observed by hunters both in ringed and harp seals. The lack of hair has no apparent effect on the health of the seals, but the skin is of course of no value to hunters. The reasons for this phenomenon are not known. The Committee urged that further research be conducted to determine the origin and ramifications of this condition in seals.

5.3 Harp seal

5.3.1 Northwest Atlantic

The Management Committee took note of the information tabled by the Observer for Canada on the new 3-year management plan for Atlantic seals (see 4). If the full quotas are taken, the total harvest by Canada and Greenland will exceed replacement yield and result in a stock decline over this period. However, given the recent rapid growth and very high current abundance of this stock, the projected harvests should pose no threat to long-term sustainability.

5.3.2 White/Barents Sea and Greenland Sea

The Management Committee noted that new information on abundance, movements and genetics will become available later this year and will be considered by the ICES/NAFO Working Group, after which it will be reviewed by the Scientific Committee.

5.4 Hooded seal

5.4.1 Northwest Atlantic

Canada noted that recent harvests from this stock had been in the low hundreds.

5.5 Northern bottlenose whales

The Scientific Committee at their next meeting will consider new abundance estimates

from NASS 1995 and 2001. The Faroe Islands informed the Committee that 6 bottlenose whales had stranded and been utilised in September 2002.

5.6 Long-finned pilot whales

The Scientific Committee at their next meeting will consider a new abundance estimate from NASS-2001. The Faroe Islands informed the Committee that efforts to tag pilot whales with satellite-linked radio transmitters would continue.

5.7 Minke whales – Central North Atlantic

Víkingsson reminded the Committee that the Scientific Committee will be undertaking a new assessment of this stock in 2003. New abundance estimates will then be available from the NASS-2001 and a revised estimate will be available from NASS-1987. He noted that methodological problems would preclude getting an unbiased estimate from the 1995 NASS aerial survey, on which the advice already given for this stock was based. However the advice given is likely still within sustainable limits as it was derived using very conservative assumptions.

Norway requested information from Iceland on any planned scientific catch of minke whales. Iceland responded that a scientific catch was under consideration, but that the issue had not been decided and no details were available.

5.8 Beluga - West Greenland

The Management Committee noted its previous conclusion that a reduction in harvesting will be required to reverse the decline of the West Greenland beluga. Greenland informed the Committee that the regulatory initiative to introduce quotas and other hunting regulations for this species had been delayed, and comprehensive public hearings have been conducted. The draft regulations have now been submitted to the Council of Hunters. It is expected that a final decision on the initiative will be taken later this year. The Management Committee welcomed this information and noted that the response of Greenland in this matter could have ramifications for the credibility of NAMMCO as an organisation.

5.9 Narwhal - West Greenland

The Management Committee noted its previous concern about the sustainability of harvests in some areas. New information on abundance in Canada and Greenland and movements from tagging experiments will soon become available, and a joint assessment meeting between the NAMMCO Scientific Committee and the Scientific Working Group of the JCNB is scheduled for 2004. Greenland informed the Committee that the regulatory initiative described for beluga and walrus would also apply to narwhal.

5.10 Fin whales - East Greenland - Iceland stock area

The Management Committee noted that a new assessment for this stock as well as the Northeast Atlantic stock was planned for 2003, using new abundance estimates from NASS-2001 and recent Norwegian surveys. The Committee discussed what emphasis should be placed on these assessments, given that Iceland had now re-joined the IWC and the issue would eventually be taken up in that forum. Iceland stated that it

expected to obtain scientific and management advice from NAMMCO for the foreseeable future. The Faroe Islands noted that they give priority to NAMMCO for advice on this and other species, and would find it regrettable if these assessment efforts were duplicated in another forum. The Scientific Committee should therefore continue to place high emphasis on the assessment of fin whales, and NAMMCO as a whole must continue to provide management advice. The Committee concluded that the Scientific Committee should continue the fin whale assessment as a high priority for 2003. The Committee also noted that these comments applied to the planned minke whale assessment (see 5.7).

5.11 Incorporation of users' knowledge in the deliberations of the Scientific Committee

The Management Committee had previously asked the Secretariat to proceed with a proposal by the Scientific Committee to use stock status reports as a starting point for discussions with resource users to incorporate their knowledge in advice to Council, and to use the stock status report on minke whales as a pilot project. However, in 2002 this process was put in abeyance pending the outcome of the NAMMCO International Conference on User Knowledge and Scientific Knowledge in Management Decision-Making, held in Reykjavik in January 2003.

The Management Committee considered the Report from the Conference presented to the Council and the discussion of the Report by the Council. It was obvious from the recommendations and conclusions from the Conference that significant work remains to take this work forward. The Management Committee therefore agreed to form a Working Group to deal with this task. The general terms of reference of the Working Group will be to use the recommendations and conclusions from the Report of the Conference as guidance to further the work of integrating user knowledge into the management decision making process. One of the tasks of the Working Group will be to re-visit the proposal already developed by the Scientific Committee and accepted by the Council, and recommend if it should proceed or be modified in some way in light of the recommendations from the Conference. More specific terms of reference may be developed at a later time. The Working Group will be composed of a small number of resource users, managers and scientists, as well as the NAMMCO Secretariat. It is anticipated that it will be formed and meet by correspondence and will report to the Management Committee at their next meeting.

6. STATUS OF PAST REQUESTS TO THE SCIENTIFIC COMMITTEE

The Chair drew the attention of the Committee to the updated summary of requests by the NAMMCO Council to the Scientific Committee, and responses by the Scientific Committee (Appendix 4).

The Vice-Chairman of the Scientific Committee reiterated the conclusion of the Scientific Committee that little progress on the items pertaining to multi-species management and marine mammal - fishery interactions can be expected unless significant new resources are directed to multispecies modelling efforts, and to the collection of data on marine mammal diet and consumption in some areas.

Greenland, while appreciating the simple format of the summary, requested that future version state explicitly whether a particular request had been fulfilled or whether more work was required.

7. NEW PROPOSALS FOR CONSERVATION AND MANAGEMENT, REQUESTS FOR ADVICE FROM THE SCIENTIFIC COMMITTEE AND RECOMMENDATIONS FOR SCIENTIFIC RESEARCH.

7.1 Economic aspects of marine mammal - fisheries interactions

7.1.1 New requests for advice

The Management Committee agreed that the Scientific Committee should monitor progress made in multi-species modelling and in the collection of input data and decide when enough progress has been made to warrant further efforts in this area. Future meetings should focus on assessing modelling results from the Scenario Barents Sea model and possibly the GADGET-based template models for other areas, if they are developed. The Scientific Committee should also consider the feasibility of connecting the multi-species models with simple economic models at that time.

7.1.2 Recommendations for scientific research

The Management Committee again noted the deficiencies in research efforts in this area identified by the Scientific Committee (see 6). The Committee emphasised the importance of research in the area of marine mammal - fishery interactions if multi-species management of marine resources was to become a realistic option. The Committee therefore reiterated the recommendations for research on the consumption by marine mammals given in 2002 (NAMMCO 2002). In addition the following research items pertaining to multi-species modelling should be given a high priority by National Governments:

- The functional nature of prey selection by marine mammals under varying levels of prey abundance and from mixtures of available prey. To derive these functions diet data must be collected in conjunction with resource surveys at appropriate temporal and spatial scales.
- theoretical and practical work on prey selection models
- development of aggregated consumption functions
- migratory and spatial aspects of consumption models
- further work on the Scenario Barents Sea model
- use GADGET as a framework to generate template models for candidate areas in the North Atlantic

7.2 Harp and hooded seals

7.2.1 New requests for advice

The Management Committee noted that new information recently had become available on the abundance of harp seals in the Greenland Sea and the Northwest Atlantic. In addition new information is available on movements and stock delineation of harp seals in the Greenland, Barents and White seas. The Management Committee therefore reiterated its previous request to the Scientific Committee to regularly update the stock status of North Atlantic harp and hooded seals as new information becomes available. The Management Committee noted the likely impact of increasing

abundance of these species on fish stocks. For harp seals in the Northwest Atlantic, the immediate management objective is to maintain the stocks at their present levels of abundance.

7.3 Harbour porpoise

There were no new proposals under this item.

7.4 Beluga - West Greenland

7.4.1 New requests for advice

The Management Committee noted that a new survey of West Greenland beluga will be conducted in 2004. The Scientific Committee was therefore requested to update the assessment of West Greenland Beluga in light of the new survey results and any other new information. The main management objective is to halt the decline of this stock.

7.5 Narwhal - West Greenland

There were no new proposals under this item.

7.6 Fin whales

There were no new proposals under this item. It was emphasised that the scheduled assessments for the East Greenland-Iceland and Northeast Atlantic stocks should proceed as a high priority for the Scientific Committee. The Committee supported the efforts of the Scientific Committee to assess the technical aspects of satellite tagging of large whales and recommend ways to increase the success of this activity in NAMMCO member countries.

7.7 White-beaked, white-sided and bottlenose dolphins

The Management Committee noted that new abundance data from the NASS-2001 and earlier surveys is now becoming available for these species. In addition, information on diet, life history and stock delineation is being collected from sampling programs conducted in the Faroe Islands and Iceland. A new sampling program for white-sided and white-beaked dolphins is being initiated in Norway. The Management Committee stressed the importance of its previous request to the Scientific Committee to continue its assessment efforts for these species once sufficient information becomes available, given the level of direct harvest in the Faroe Islands and the known interactions with fisheries in NAMMCO member countries.

7.8 North Atlantic Sightings Surveys

7.8.1 Recommendations for scientific research

The Management Committee took note of the Welcome Address given by the Scientific Secretary on this topic. The Committee considered that the information on abundance, trends in abundance and distribution provided by the series of NASS is crucially important in the management of cetacean stocks throughout the North Atlantic. It is also important in the assessment of the potential interactions between these species and fisheries, in that information on distribution and abundance is essential for estimating consumption by whales. Such information can only be provided by synoptic surveys that cover a very broad area, and that are conducted at time intervals suitable for detecting trends in abundance. The co-ordination of survey

methodologies among participating parties is also required. The Committee therefore recommended that member countries continue to co-ordinate cetacean surveys across the North Atlantic, and attempt to broaden the coverage of these surveys through the inclusion of other participants, particularly in the Northwest Atlantic.

7.9 Others

7.9.1 Minke whales

The Management Committee recalled its recommendation from 2002 that the Scientific Committee should complete an assessment of Central Atlantic minke whales once new abundance estimates from NASS-2001 become available, and noted that this assessment will be carried out in 2003.

The Management Committee considered a suggestion made by the observer from the High North Alliance to broaden the request for advice to include the Northeast Atlantic stock of minke whales. The suggested request would include an assessment of the effects of various annual catch levels on the stock over various time periods, and an estimation of replacement yield after catches at these levels and time periods. Other points included an estimation of the catch levels required to reduce the stock to 70 - 80 thousand animals over various time periods, and recommendations for the type of monitoring required to determine the effects of these management measures.

The Management Committee noted this suggestion. It was not decided to put this forward as a request for advice to the Scientific Committee.

7.9.2 Grey Seals

The Management Committee noted that the Scientific Committee would be responding to its request from 2002 to conduct an assessment of grey seal populations throughout the North Atlantic in the next year.

7.9.3 Humpback whales

The Management Committee recalled its request from 2002 to complete abundance estimates for this species as a high priority, and to consider the results of the "Years of the North Atlantic Humpback" (YoNAH) project as they pertain to member countries. The Committee noted with satisfaction that new abundance estimates from the NASS-1995 and 2001 would be completed and considered by the Scientific Committee within the coming year.

8. REPORT OF THE WORKING GROUP ON BY-CATCH

Kim Mathiasen, Chairman of the Working Group on Bycatch, presented the report of the teleconference held 17 February 2003 (See section 2.2).

The Working Group reviewed the progress of member countries in establishing systems to effectively monitor bycatch. No new initiatives have been taken in the Faroe Islands or Greenland. An effort to improve reporting of bycatch through fishery logbooks was initiated in 2002 for gillnet fisheries in Iceland. Results to date indicate that the rate of reporting is still low and improvements to the system are required. In

2003 the reporting system will be expanded to include all Icelandic fisheries. In Norway the mandatory reporting of bycatch through fishery logbooks is being supplemented through other measures including independent observers in a sub-sample of the offshore fleet and the establishment of a "reference fleet" from which more detailed information will be collected. Methods for collecting bycatch data from small coastal vessels (*sjark*) are still under development. It is expected that the new system will begin to return useable data within the next few months. The Working Group considered that procedures for the monitoring of bycatch in NAMMCO member countries had not yet reached a stage of implementation where an evaluation could be conducted. At least another year would be required before the systems in Norway and perhaps Iceland were at a stage where a useful evaluation could be conducted.

Some modifications to the format of the National Progress Reports were made to improve the reporting of bycatch by member countries to NAMMCO. The Working Group noted that reporting by some countries was still inadequate and that the new format was not being used consistently.

There had been an increase in the number of large cetaceans entangled in fishing gear in West Greenland in recent years. In some cases these animals are still alive when found and are killed by the fishermen after receiving permission from the Greenlandic authorities. The Management Committee agreed to refer the matter of the killing methods employed in large whale entanglements to the Committee on Hunting Methods to obtain advice on the procedures that could be employed in such situations.

The Management Committee supported the following recommendations of the Working Group:

i. As recommended in 2002, member countries should report their bycatch to NAMMCO through the new National Progress Report format.

ii. As soon as one member country has a functioning bycatch monitoring system in place, the Working Group should meet to conduct a full evaluation of the system and make recommendations on bycatch monitoring to all member countries. The evaluation should focus on the practical and logistical aspects of the reporting system. It was anticipated that this could be done within the next 12 to 24 months.

The Management Committee noted that the Scientific Committee would be required to evaluate the accuracy and precision of bycatch data in their assessments of any stocks that are subject to bycatch.

9. REPORT OF THE COMMITTEE ON INSPECTION AND OBSERVATION

The Chair of the Management Committee on Inspection and Observation, Egil Ole Øen, presented the report from the first meeting held on 31 January 2003 (See section 2.3).

The Committee reviewed the experiences with the implementation of the Scheme and pointed out some areas for improvements. In general the Committee saw no serious obstacles as to upgrading the routines and making the implementation process run more smoothly. The Committee emphasised that the Inspection and Observation Scheme is working according to the intentions laid down in the provisions of the Scheme and underlined that NAMMCO is the only organisation that has a well functioning international Inspection and Observation Scheme for whaling and sealing.

The Management Committee noted the recommendations for improving the implementation of the Scheme. It was decided that the budget for the Scheme would not be increased at this time. The Committee endorsed the recommendation that observations should be focussed on particular hunting activities and/or regions in some years. Furthermore the recommendation that the member countries nominate more than one observer candidate to facilitate the implementation of the Scheme was supported.

10. IMPLEMENTATION OF THE JOINT NAMMCO CONTROL SCHEME

10.1 NAMMCO International Observation Scheme 2002

The Chair referred to the Report of the NAMMCO International Observation Scheme under the Joint Control Scheme for the Hunting of Marine Mammals, prepared by the Secretariat. The Administrative Co-ordinator Charlotte Winsnes presented the report to the Management Committee.

In 2002 land-based observations of whaling and sealing activities were conducted in the Faroe Islands, Greenland and Norway. In addition, shipboard observations of whaling were conducted in Greenland and Norway. No observations of Norwegian sealing activities were conducted. Reporting was complete in all cases and no violations were observed. Observations conducted onboard vessels were found to be less expensive than land-based observations due to the low accommodation costs. However the opportunities to accommodate an observer on Norwegian vessels are limited. There is a continued lack of awareness about NAMMCO and the Scheme among marine mammal hunters in some areas.

The Management Committee noted that for the first time on-board observation with a duration of more than one day had been conducted, and encouraged further expansion in this direction.

10.2 NAMMCO International Observation Scheme 2003

The Management Committee agreed to that the observations for 2003 would focus on shipboard and land based whaling activities in Norway.

11. ANY OTHER BUSINESS

11.1 Ecosystem approach to management

The Management Committee noted that the Agreement establishing NAMMCO

identified an ecosystem approach to the management of living marine resources as a desired objective. NAMMCO has been in the forefront of work in this area, particularly with regard to the activities of the Scientific Committee in the assessment of marine mammal - fisheries interactions. However the Management Committee considered that a more broad-based approach was also needed, to consider the changes in management systems that might be required when using a multi-species, ecosystem-based approach to management. It was therefore decided to establish an *ad hoc* Working Group on Enhancing Ecosystem-based Management, mainly composed of managers. The general objective of the Working Group will be to investigate the progress that has been made in other fora in implementing ecosystem-based management, and recommending what sorts of principles and measures can be applied to the situations faced by NAMMCO member and neighbouring countries. As the work of the Working Group involves ecosystems that include jurisdictions of non-member countries, it was considered important that those countries, in particular Canada and the Russian Federation, participate in the Working Group to the extent possible. Given the holistic nature of the issue it was agreed that those non-members be invited to participate fully in the Working Group, as specially invited participants rather than as observers. The Working Group will forward a report to the Management Committee prior to its next meeting in 2004.

12. ADOPTION OF REPORT

The report was adopted on March 6, 2003. The Management Committee thanked the rapporteur for his efforts. The Management Committee agreed to Faroe Islands' recommendation that NAMMCO member countries appoint members to a drafting group to assist the rapporteur in writing the reports at future meetings.

Appendix 1

AGENDA

1. Chairman's opening remarks
2. Adoption of agenda
3. Appointment of rapporteur
4. National Progress Reports
5. Status of past proposals for conservation and management
   - 5.1 Atlantic walrus
   - 5.2 Ringed seal
   - 5.3 Harp seal
     - 5.3.1 Northwest Atlantic
     - 5.3.2 White/Barents Sea
     - 5.3.3 Greenland Sea
   - 5.4 Hooded seal
     - 5.4.1 Northwest Atlantic
     - 5.4.2 Greenland Sea
   - 5.5 Northern bottlenose whales
   - 5.6 Long-finned pilot whales
   - 5.7 Minke whales – Central North Atlantic
   - 5.8 Beluga - West Greenland
   - 5.9 Narwhal - West Greenland
   - 5.10 Fin whales - East Greenland - Iceland stock area
   - 5.11 Incorporation of users' knowledge in the deliberations of the Scientific Committee
6. Status of past requests to the Scientific Committee
7. New proposals for conservation and management, requests for advice from the Scientific Committee and recommendations for scientific research.
   - 7.1 Economic aspects of marine mammal - fisheries interactions
     - 7.1.1 Proposals for conservation and management
     - 7.1.2 New requests for advice
     - 7.1.3 Recommendations for scientific research
   - 7.2 Harp and hooded seals
     - 7.2.1 Proposals for conservation and management
     - 7.2.2 New requests for advice
     - 7.2.3 Recommendations for scientific research
   - 7.3 Harbour porpoise
     - 7.3.1 Proposals for conservation and management
     - 7.3.2 New requests for advice
     - 7.3.3 Recommendations for scientific research
   - 7.4 Beluga - West Greenland
     - 7.4.1 Proposals for conservation and management
     - 7.4.2 New requests for advice
     - 7.4.3 Recommendations for scientific research
   - 7.5 Narwhal - West Greenland
     - 7.5.1 Proposals for conservation and management
     - 7.5.2 New requests for advice
     - 7.5.3 Recommendations for scientific research

7.6 Fin whales
- 7.6.1 Proposals for conservation and management
- 7.6.2 New requests for advice
- 7.6.3 Recommendations for scientific research

7.7 White-beaked, white-sided and bottlenose dolphins
- 7.7.1 Proposals for conservation and management
- 7.7.2 New requests for advice
- 7.7.3 Recommendations for scientific research

7.8 North Atlantic Sightings Surveys
- 7.8.1 Proposals for conservation and management
- 7.8.2 New requests for advice
- 7.8.3 Recommendations for scientific research

7.9 Others

8. Report of the Working Group on Bycatch
9. Report of the Committee on Inspection and Observation
10. Implementation of the Joint NAMMCO Control Scheme
    - 10.1 NAMMCO International Observation Scheme 2002
    - 10.2 NAMMCO International Observation Scheme 2003
    - 10.3 Other matters
11. Any other business
12. Adoption of report

Appendix 2

LIST OF DOCUMENTS

NAMMCO/12/MC/1	List of documents
NAMMCO/12/MC/2	Agenda
NAMMCO/12/MC/3	Status of proposals for conservation and management (up to and including NAMMCO/11)
NAMMCO/12/MC/4	Summary of requests by NAMMCO Council to the Scientific Committee, and responses by the Scientific Committee
NAMMCO/12/MC/5	Report of the Management Working Group on By-catch
NAMMCO/12/MC/6	Report of the Committee on Inspection and Observation
NAMMCO/12/MC/7	Report of the NAMMCO International Observation Scheme 2002

National Progress Reports

NAMMCO/SC/10/NPR-F	Faroe Islands - Progress Report on Marine Mammal Research in 2001
NAMMCO/SC/10/NPR-G	Greenland - Progress Report on Marine Mammal Research in 2001
NAMMCO/SC/10/NPR-I	Iceland - Progress Report on Marine Mammal Research in 2001
NAMMCO/SC/10/NPR-N	Norway - Progress Report on Marine Mammal Research in 2001

Council documents

NAMMCO/12/5	Report of the Scientific Committee, 17-19 September 2002

Appendix 3

LIST OF PAST PROPOSALS FOR CONSERVATION AND MANAGEMENT

(Up to and including NAMMCO/12 - 2003)

PINNIPEDS

1 Atlantic walruses

Proposal for conservation and management:

The Management Committee examined the advice of the Scientific Committee on Atlantic Walrus and noted the apparent decline which the Scientific Committee identified in respect to "functional" stocks of walrus of Central West Greenland and Baffin Bay.

While recognising the over all priority of further work to clarify and confirm the delineation and abundance of walrus stocks in the North Atlantic area, the Management Committee recommends that Greenland take appropriate steps to arrest the decline of walrus along its west coast.

Taking into account the views of the Scientific Committee that the Baffin Bay walrus stock is jointly shared with Canada and that the West Greenland stock might be shared, the Management Committee encourages Canada to consider working co-operatively with Greenland to assist in the achievement of these objectives (*NAMMCO Annual Report 1995*: 49).

Management measures/response by member countries:

Greenland provided the Management Committee with information on further measures recently implemented through legislation by the Greenland authorities for the conservation of the West Greenland stock. These regulations include: the restriction of walrus hunting to people with valid professional hunting licences only; a year-round ban on walrus hunting south of 66° N; limitations on the means of transport used in connection with walrus hunting to dog sleds and vessels of 19.99 GRT/31.99 GT or less; and the sale of walrus products limited to direct sales at open markets or for personal use only. Municipal authorities now also have the possibility of implementing further restrictions if circumstances require. (*NAMMCO/8*)

Greenland noted that in addition to the regulatory measures that were taken in 1999, it had been decided to introduce quotas on walrus. A new regulatory proposal has been drafted and public hearings will be held in the near future. The final regulatory proposal will take these hearings into account. (*NAMMCO/11*)

Greenland informed the Committee that the regulatory initiative to introduce quotas and other hunting regulations for this species had been delayed, and comprehensive public hearings have been conducted. The draft regulations have now been submitted to the Council of Hunters. It is expected that a final decision on the initiative will be taken later in 2003 (*NAMMCO/12*).

2. Ringed seals

2.1 *Proposal for conservation and management*

The Management Committee noted the conclusions of the Scientific Committee on the assessment of ringed seals in the North Atlantic, which had been carried out through the Scientific Committee Working Group on Ringed Seals. In particular, the Management Committee noted that three geographical areas had been identified for assessing the status of ringed seals, and that abundance estimates were only available for Area 1 (defined by Baffin Bay, Davis Strait, eastern Hudson Strait, Labrador Sea, Lancaster, Jones and Smith sounds (*NAMMCO/6*).

Management measures/response by member countries:

None.

2.2 *Proposal for conservation and management*

While recognising the necessity for further monitoring of ringed seal removals in Area 1, the Management Committee endorsed the Scientific Committee's conclusions that present removals of ringed seals in Area 1 can be considered sustainable (*NAMMCO /6).*

Management measures/response by member countries:

The Greenland government is presently undertaking a regulatory initiative which will deal with hunting of all seals in Greenland, rather than just harbour seals as at present (*NAMMCO/11*).

3. Harp seals in the Northwest Atlantic

3.1 Northwest Atlantic

3.1.1 *Proposal for conservation and management*

The Management Committee noted that a new abundance estimate for Northwest Atlantic harps seals of 4.8 million was available, based on a pup production estimate for 1994 of 702,900. The Management Committee also noted the conclusion that the Northwest Atlantic population of harp seals has been growing at a rate of 5% per year since 1990, and that the 1996 population was estimated to be 5.1 million, with a Calculated replacement yield of 287,000.

The Management Committee concluded that catch levels of harp seals in Greenland and Canada from 1990 to 1995 were well below the calculated replacement yields in this period (*NAMMCO /6*).

Management measures/response by member countries:

None.

3.1.2 *Proposal for conservation and management*

The Management Committee noted that combined estimated catches of harp seals in Canada and Greenland are in the order of 300,000 and that these catches are near or at, the established replacement yields (*NAMMCO/8*).

Management measures/response by member countries:

Canada brought to the attention of the Committee the recently completed Report of the Eminent Panel on Seal Management, which contains a full review of research and management of seals in Canada, with a primary focus on Northwest Atlantic harp and hooded seals. The Report is available at the following web site: http://www.dfo-mpo.gc.ca/seal-phoque/reports/index.htm. Canada also noted that an abundance survey of the Northwest Atlantic harp seals had been completed in 1999, and that published results were now available. (*NAMMCO/11*)

Greenland commented that sustainable catches may be obtained at other catch levels than those that provide replacement yields. (*NAMMCO/11*)

The Observer for Canada presented information on a multi-year management plan for the Atlantic seal hunt, which was announced in February 2003. For harp seals total allowable catch is set at 975,000 over a 3-year period. If the full quota were taken and Greenlandic harvests were as forecast, the total take should result in a slight population reduction over the period, while still maintaining the population well above the conservation reference points adopted (*NAMMCO/12*).

3.2 White/Barents Sea

Proposal for conservation and management

The Management Committee noted the stock status and catch options presented by the Scientific Committee, and concluded that the catch level in 1998 was well below the calculated replacement yield. Catches at the same level in the future may result in population increase. From a resource management point of view, future quota levels approaching the replacement yield are advised. (*NAMMCO/9*).

Management measures/response by member countries:

None.

3.3 Greenland Sea

Proposal for conservation and management

The Management Committee noted the stock status and catch options presented by the Scientific Committee, and concluded that the catch level in 1998 was well below the calculated replacement yield. Catches at the same level in the future may result in population increase. From a resource management point of view, future quota levels approaching the replacement yield are advised. (*NAMMCO/6*)

Management measures/response by member countries:

None.

4. Hooded seals

4.1 *Northwest Atlantic*

4.1.1 *Proposal for conservation and management*

Noting the Scientific Committee's review of available analyses of hooded seal pup production, which recognised that calculations are dependent on the particular rate of pup mortality used, as well as the harvest regimes, the Management Committee

concluded that present catches of hooded seals in the Northwest Atlantic (1990-1995) were below the estimated replacement yields of 22,900 calculated for a harvest of pups only, and 11,800 calculated for a harvest of 1-year and older animals only (*NAMMCO/6*).

Management measures/response by member countries:

None.

4.1.2 *Proposal for conservation and management*

The Management Committee noted that the total catch of hooded seals in the Northwest Atlantic in 1996 slightly exceeded the replacement yield while in 1997 the total number of seals taken was much lower (*NAMMCO/8*).

Management measures/response by member countries:

Greenland noted that this stock was shared with Canada and that the two countries hold regular bilateral discussions on management of this stock, including an exchange of information on harvest statistics, utilisation and stock assessment. (*NAMMCO/11*)

4.2 Greenland Sea

Proposal for conservation and management

The Management Committee noted the stock status and catch options presented by the Scientific Committee, and concluded that the catch level in 1998 was well below the calculated replacement yield. Catches at the same level in the future may result in population increase. From a resource management point of view, future quota levels approaching the replacement yield are advised (*NAMMCO/9*).

Management measures/response by member countries:

While supporting the past conclusion of the Management Committee that catch levels for this stock are below replacement yield, Norway noted that the abundance estimate for this stock is dated and that it hoped that new information should soon be available from surveys planned for 2002. (*NAMMCO/11*)

CETACEANS

5 Northern bottlenose whales

Proposal for conservation and management

The Management Committee discussed the advice of the Scientific Committee on the status of the northern bottlenose whale and noted that this was the first conclusive analysis on which management of the northern bottlenose whale could be based.

The Management Committee accepted that the population trajectories indicated that the traditional coastal drive hunt in the Faroe Islands did not have any noticeable effect on the stock and that removals of fewer than 300 whales a year were not likely to lead to a decline in the stock (*NAMMCO/5*)

Management measures/response by member countries:

None.

6 Long-finned pilot whales

Proposal for conservation and management

The Management Committee noted the findings and conclusions of the Scientific Committee, through its review of the ICES Study Group Report and the analysis of data from NASS-95 with respect to the status of long-finned pilot whales in the North Atlantic (Section 3.1, item 3.1), which also confirmed that the best available abundance estimate of pilot whales in the Central and Northeast Atlantic is 778,000. With respect to stock identity it was noted that there is more than one stock throughout the entire North Atlantic, while the two extreme hypotheses of i) a single stock across the entire North Atlantic stock, and ii) a discrete, localised stock restricted to Faroese waters, had been ruled out.

The Management Committee further noted the conclusions of the Scientific Committee that the effects of the drive hunt of pilot whales in the Faroe Islands have had a negligible effect on the population, and that an annual catch of 2,000 individuals in the eastern Atlantic corresponds to an exploitation rate of 0.26%.

Based on the comprehensive advice which had now been provided by the Scientific Committee to requests forwarded from the Council, the Management Committee concluded that the drive hunt of pilot whales in the Faroe Islands is sustainable (*NAMMCO/7*).

Management measures/response by member countries:

In 1997 the Management Committee concluded that the Faroese drive hunt of pilot whales is sustainable. There have been no changes in annual take, new abundance estimates or other information that warrant any change in this conclusion. (*NAMMCO/11*)

7. Minke Whales - Central North Atlantic

Proposal for conservation and management

The Management Committee accepted that for the Central Stock Area the minke whales are close to their carrying capacity and that removals and catches of 292 animals per year (corresponding to a mean of the catches between 1980-1984) are sustainable. The Management Committee noted the conservative nature of the advice from the Scientific Committee (*NAMMCO/8)*

Management measures/response by member countries:

None.

8. Beluga - West Greenland

8.1 *Proposal for conservation and management*

Maniitsoq – Disko

The Management Committee noted that a series of surveys conducted since 1981 indicate a decline of more than 60% in abundance in the area Maniitsoq to Disko. It

further noted that with the present harvest levels (estimated at 400/yr) the aggregation of belugas in this area is likely declining due to overexploitation.

Avanersuaq – Upernavik
The present harvest in the area Avanersuaq - Upernavik is estimated to be more than 100/yr. The Management Committee noted that since this beluga occurrence must be considered part of those wintering in the area from Maniitsoq to Disko, it is considered to be declining due to overexploitation.

Finally the Management Committee noted the conclusion by the Scientific Committee that with the observed decline a reduction in harvesting in both areas seems necessary to halt or reverse the trend *(NAMMCO/9).*

Management measures/response by member countries:

Greenland stated that this issue again will be thoroughly discussed with the hunters, and that the Greenland Government does share the concerns expressed. (*NAMMCO/10*)

Greenland informed the Committee that in November 2000 the government made a decision to introduce harvest quotas for beluga and narwhal. Public hearings on a draft regulatory proposal were held in spring 2001. The results of these hearings are being taken into account in the drafting of a revised regulatory proposal, and a final set of regulations is expected to be introduced sometime in 2002 (*NAMMCO/11*).

Greenland informed the Committee that the regulatory initiative to introduce quotas and other hunting regulations for this species had been delayed, and comprehensive public hearings have been conducted. The draft regulations have now been submitted to the Council of Hunters. It is expected that a final decision on the initiative will be taken later in 2003 (*NAMMCO/12*).

8.2 *Proposal for conservation and management*

It was accepted that the Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB) would provide management advice for this stock, which is shared by Canada and Greenland. The Management Committee therefore recommended that closer links be developed between NAMMCO and the JCNB on this and other issues of mutual concern. Greenland stated that this issue again will be thoroughly discussed with the hunters, and that the Greenland Government does share the concerns expressed *(NAMMCO/10)*

Management measures/response by member countries:

None

8.3 *Proposal for conservation and management*

In 2000 the Management Committee accepted that the Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB) would provide management advice for this stock, which is shared by Canada and Greenland. The Management Committee noted with pleasure that a joint meeting of the

NAMMCO Scientific Working Group on the Population Status of North Atlantic Narwhal and Beluga and the JCNB Scientific Working Group had been held in May 2001, and recommended that this co-operation at the scientific level should continue. The Management Committee also reiterated its recommendation that closer links be developed between NAMMCO and the JCNB on this and other issues of mutual concern. *(NAMMCO/10)*

Management measures/response by member countries:

None

9. Narwhal - West Greenland

9.1 *Proposal for conservation and management*

Avanersuaq

The Management Committee noted that the present exploitation level in Avanersuaq of 150/yr seems to be sustainable, assuming that the same whales are not harvested in other areas

Melville Bay – Upernavik

The Management Committee noted that the Scientific Committee could give no status for the Melville Bay – Upernavik summering stock.

Uummannaq

The Management Committee noted that the substantial catches (several hundreds) in some years do cause concern for the status of this aggregation. The Management Committee further noted that the abundance of narwhal in this area should be estimated.

Disko Bay

The Management Committee noted that present catches in this area are probably sustainable.

Catch Statistics

The Management Committee noted that for both narwhal and beluga it is mandatory for future management that more reliable catch statistics (including loss rates) are collected from Canada and Greenland (*NAMMCO/9*).

Management measures/response by member countries:

As for beluga, harvest quotas will be introduced for West Greenland narwhal in the near future (*NAMMCO/11*).

Greenland informed the Committee that the regulatory initiative to introduce quotas and other hunting regulations for this species had been delayed, and comprehensive public hearings have been conducted. The draft regulations have now been submitted to the Council of Hunters. It is expected that a final decision on the initiative will be taken later in 2003 *(NAMMCO/12*).

9.2 *Proposal for conservation and management*

The Management Committee accepted that the JCNB would provide management advice for this stock, which is shared by Canada and Greenland. The Management Committee therefore recommended that closer links be developed with the JCNB on this and other issues of mutual concern. *(NAMMCO/10)*

Management measures/response by member countries:

None

10. North Atlantic fin whales

Proposal for conservation and management

The Management Committee accepted that for fin whales in the East Greenland – Iceland (EGI) stock area, removals of 200 animals per year would be unlikely to bring the population down below 70% of its pre-exploitation level in the next 10 years, even under the least optimistic scenarios. However, catches at this level should be spread throughout the EGI stock area, roughly in proportion to the abundance of fin whales observed in the NASS surveys. Furthermore, the Management Committee stressed that the utilisation of this stock should be followed by regular monitoring of the trend in the stock size.

The Management Committee also noted the conservative nature of the advice from the Scientific Committee on which the conclusion of the Management Committee was *based (NAMMCO/9)*

Management measures/response by member countries:

None

11. Incorporation of the users' knowledge in the deliberations of the Scientific Committee

11.1 *Proposal for conservation and management*

The Management Committee endorsed the proposals and viewpoints contained in section 6 in the Scientific Committee report, and suggested that the "Draft Minke Whale Stock Status Report" (*NAMMCO/9/7*) could usefully serve as a pilot project for co-operation with the hunters. (*NAMMCO/9*)

Management measures/response by member countries:

Status Reports under development.

11.2 *Proposal for conservation and management*

The Management Committee had previously asked the Secretariat to proceed with a proposal by the Scientific Committee to use stock status reports as a starting point for discussions with resource users to incorporate their knowledge in advice to Council, and to use the stock status report on minke whales as a pilot project. However, in 2000 the Management Committee recommended that a proposal for a conference on incorporating user knowledge and scientific knowledge into management advice should proceed, and asked the Conference Advisory Group to plan this conference to

evaluate whether and how the previous proposal for incorporating user knowledge into the Scientific Committee's deliberations could be incorporated into the Conference (*NAMMCO/11*).

Management measures/response by member countries:

Greenland informed the Committee that a person had been hired at the Greenland Institute of Natural Resources to deal with these issues, and that this employee is also on the Advisory Board of the Conference. (*NAMMCO/11*)

List of References

NAMMCO/1
NAMMCO 1992. (MS) Report of the inaugural meeting of the Council of the North Atlantic Marine Mammal Commission. NAMMCO, University of Tromsø, Tromsø, 35 pp.

NAMMCO/2
NAMMCO. 1993. (MS) Report of the second meeting of the Council. NAMMCO, University of Tromsø, Tromsø, 65 pp.

NAMMCO/3
NAMMCO. 1993. (MS) Report of the third meeting of the Council. NAMMCO, University of Tromsø, Tromsø, 51 pp.

NAMMCO/4
NAMMCO. 1994. (MS) Fourth meeting of the Council. NAMMCO, University of Tromsø, Tromsø, 142 pp.

NAMMCO/5
NAMMCO. 1995. Fifth meeting of the Council. In: NAMMCO, *Annual Report 1995.* NAMMCO, Tromsø, 11-44.

NAMMCO/6
NAMMCO. 1997. Report of the sixth meeting of the Council. In: NAMMCO, *Annual Report 1996.* NAMMCO, Tromsø, 11-58.

NAMMCO/7
NAMMCO. 1998. Report of the seventh meeting of the Council. In: NAMMCO, *Annual Report 1997.* NAMMCO, Tromsø, 9-60.

NAMMCO/8
NAMMCO. 1999. Report of the eighth meeting of the Council. In: NAMMCO, *Annual Report 1998.* NAMMCO, Tromsø, 9-55.

NAMMCO/9
NAMMCO. 2000. Report of the ninth meeting of the Council. In: NAMMCO, *Annual Report 1999.* NAMMCO, Tromsø, 11-49.

NAMMCO/10
NAMMCO. 2001. Report of the tenth meeting of the Council. In: NAMMCO, *Annual Report 2000*. NAMMCO, Tromsø, , 11-69.

NAMMCO/11
NAMMCO. 2002. Report of the eleventh meeting of the Council. In: NAMMCO, *Annual Report 2001*. NAMMCO, Tromsø, 11-93.

NAMMCO/12
NAMMCO. 2003. Report of the twelfth meeting of the Council. In: NAMMCO, *Annual Report 2002*. NAMMCO, Tromsø, (this volume).

Appendix 4

SUMMARY OF REQUESTS BY NAMMCO COUNCIL TO THE SCIENTIFIC COMMITTEE, AND RESPONSES BY THE SCIENTIFIC COMMITTEE

The following provides a summary of all requests by NAMMCO Council to the Scientific Committee (including the 11th meeting), and notes the response of the Scientific Committee (SC) to these requests. Requests forwarded from NAC (North Atlantic Committee for Co-operation on Research on Marine Mammals) to ICES (International Council for the Exploration of the Sea) prior to NAMMCO's establishment, and which were carried over to NAMMCO in 1992, are included. This document will be continually updated to serve as a resource for both the Council and the Scientific Committee.

1. ROLE OF MARINE MAMMALS IN THE ECOSYSTEM

Marine Mammal - Fish Interaction:

Code/Meeting: 1.1/ NAMMCO/1
Request:

To provide an overview of the current state of knowledge of the dependence of marine mammals on the fish and shrimp stocks and the interrelations between these compartments

Response of the Scientific Committee:

See 1.2, 1.4, 1.7, 1.9, 1.10.

Code/Meeting: 1.2/NAMMCO/1
Request:

In the multi-species context ... to address specific questions related to the Davis Strait ecosystem such as: - the apparent increase in harp seal stocks; - its influence on the economically important shrimp and cod stocks; - the impact of the fisheries on marine mammals, particularly harp seals; - the southward shift of minke whale distribution in recent years, and - observed changes in oceanographical conditions after the 1970s; - and to the East Greenland-Iceland-Jan Mayen area interactions between capelin stocks, fishery and marine mammals

Response of the Scientific Committee:

- Questions related to harp and hooded seals were forwarded to the ICES/NAFO Joint Working Group on Harp and Hooded Seals (SC/2) - Specific questions related to the Davis Strait ecosystem were not addressed. - See also 1.4, 1.7, 1.9, and 1.10.

Code/Meeting: 1.3/NAMMCO/2
Request:

To assess the impact of marine mammals on the marine ecosystem, with special emphasis on the availability of economically important fish species

Response of the Scientific Committee:

See 1.2, 1.4, 1.7, 1.9, 1.10

Code/Meeting: 1.4/ NAMMCO/6
Request:

The Scientific Committee was requested to focus its attention on the food consumption of three predators in the North Atlantic: the minke whale, the harp seal and the hooded seal, with a particular emphasis on the study of the potential implications for commercially important fish stocks.

Response of the Scientific Committee:

The Scientific Committee established a Working Group on the Role of Minke Whales, Harp Seals and Hooded Seals in the North Atlantic. The Scientific Committee used the report of this Working Group to provide advice to Council, and to recommend further research. (SC/5) Many of the papers presented will be published in Volume 2 of NAMMCO Scientific Publications. (SC/7)

Code/Meeting: 1.5/NAMMCO/7
Request:

The Council encourages scientific work that leads to a better understanding of interactions between marine mammals and commercially exploited marine resources, and requested the Scientific Committee to periodically review and update available knowledge in this field.

Response of the Scientific Committee:

See 1.9, 1.10

Multi-species approaches to management:

Code/Meeting: 1.6/NAMMCO/1
Request:

To consider whether multi-species models for management purposes can be established for the North Atlantic ecosystems and whether such models could include the marine mammals compartment. If such models and the required data are not available then identify the knowledge lacking for such an enterprise to be beneficial to proper scientific management and suggest scientific projects which would be required for obtaining this knowledge.

Response of the Scientific Committee:

See 1.4, 1.7, 1.9, 1.10

Code/Meeting: 1.7/NAMMCO/5
Request:

In relation to the importance of the further development of multi-species approaches to the management of marine resources, the Scientific Committee was requested to

monitor stock levels and trends in stocks of all marine mammals in the North Atlantic.

Response of the Scientific Committee:

It was clarified that the purpose of this request was to ensure that data on marine mammals was available for input into multi-species models for management. The Committee agreed that updated information on abundance and indications of trends in abundance of stocks of marine mammals in the North Atlantic should be clearly described in a new document for the internal reference of the Council, to replace the List of Priority Species. This document would be entitled Status of Marine Mammals in the North Atlantic and should include those cetacean and pinniped species already contained in the List of Priority Species, as well as other common cetacean species in the NAMMCO area for which distribution and abundance data is also available (fin, sei, humpback, blue, and sperm whales). (SC/5)

Sealworm infestation:

Code/Meeting: 1.8/NAMMCO/6

Request:

Aware that the population dynamics of the sealworm (*Pseudoterranova decipiens*) may be influenced by sea temperature, bathymetry, invertebrate and fish fauna, the Scientific Committee was requested to review the current state of knowledge with respect to sealworm infestation and to consider the need for comparative studies in the western, central and eastern North Atlantic coastal areas, taking into account the priority topics recommended by the Scientific Committee and its *ad hoc* Working Group on grey seals.

Response of the Scientific Committee:

The Scientific Committee established a Working Group on Sealworm Infection to address this question. The Scientific Committee used their report as the basis for providing advice to Council, and developing recommendations for further research. (SC/5) Many of the papers considered by the Working Group will are published in *NAMMCO Scientific Publications* Vol. 3 *Sealworms in the North Atlantic: Ecology and population dynamics* (SC/7)

Economic aspects of marine mammal-fisheries interactions:

Code/Meeting: 1.9/NAMMCO/7

Request:

The Council requested that special attention be paid to studies related to competition and the economic aspects of marine mammal-fisheries interactions

Response of the Scientific Committee:

The Scientific Committee established a Working Group on Economic Aspects of Marine Mammal-Fisheries Interactions. The Scientific Committee concluded that inclusion of economic considerations is a valuable addition to mullet-species models of interactions between marine mammals and fisheries. The work presented at the Working Group was considered the first step towards more complete analyses of these interactions and it was recommended, in light of the economic impacts, that more complete models should be developed and presented. The Scientific Committee showed a continued interest in the development of the models and it was decided to

maintain the Working Group and seek further guidance from the Council on matters of particular interest. (SC/6)

Code/Meeting: 1.10/NAMMCO/8
Request:

The Scientific Committee is requested to investigate the following economic aspects of marine mammal – fisheries interactions:

- to identify the most important sources of uncertainty and gaps in knowledge with respect to the economic evaluation of harvesting marine mammals in the different areas;
- to advise on research required to fill such gaps both in terms of refinement of ecological and economical models and collection of basic biological and economical data required as input parameters for the models;
- to discuss specific cases where the state of knowledge may allow quantification of the economic aspects of marine mammal – fisheries interactions:
  a) what could be the economic consequences of a total stop in harp seal exploitation versus different levels of continued sustainable harvest?
  b) what could be the economic consequences of different levels of sustainable harvest vs. no exploitation of minke whales?

Response of the Scientific Committee:

The Working Group On The Economic Aspects Of Marine Mammal - Fisheries Interactions was reactivated to meet this request. It was agreed to separate the request into two sections. At the first Working Group meeting the first two items in the request were addressed. The Working Group used available information to derive estimates of consumption of cod, herring, capelin and shrimp by harp seals, minke whales and *Lagenorhynchus* spp. and bottlenose dolphins in some areas. Multi-species models presently in use or under development in Norway and Iceland offer a means of assessing the impact of marine mammal predation on fish stocks The Scientific Committee therefore recommended that the next logical step in addressing the request should be for NAMMCO to lead or assist in the development of a multi-species-economic model for a candidate area. However, the Scientific Committee reiterated that the estimation and model uncertainties are such that definitive quantification of the economic aspects of marine mammal-fisheries interactions in candidate areas cannot be expected in the near term. (SC/8)

Code/Meeting: 1.11/NAMMCO/10
Request:

Noting the requests for advice from the Council at its Eighth meeting in Oslo 1998 (see Annual Report 1998 page 23), the Management Committee recommended that the Scientific Committee continue the assessment of the economic aspects of fishery - marine mammal interactions in the two areas (Barents Sea and Iceland) and with the two species (minke whales and harp seals) that have been identified as feasible for this assessment.

Response of the Scientific Committee:

The Scientific Committee convened a workshop under the theme "Marine Mammals: From feeding behaviour or stomach contents to annual aonsumption - what are the main uncertainties ", to further investigate the methodological and analytical problems

in estimating consumption by marine mammals. (SC/9)

Code/Meeting: 1.12/NAMMCO/11
Request:

The Management Committee noted the conclusion of the Scientific Committee that the estimation and model uncertainties are such that the economic aspects of marine mammal-fishery interactions in candidate areas cannot be quantified without further work. The Management Committee therefore recommended that the Scientific Committee should hold a workshop on ecosystem models aiming for a better understanding of the ecological role of minke whales and harp and hooded seals in the North Atlantic, as proposed in the Scientific Committee report.

Response of the Scientific Committee:

The Scientific Committee convened a workshop, under the theme "Modelling Marine Mammal – Fisheries Interactions in the North Atlantic", to investigate how presently available ecosystem models can be adapted for quantifying marine mammal - fishery interactions. (SC/10)

Code/Meeting: 1.13/NAMMCO/12
Request:

The Management Committee agreed that the Scientific Committee should monitor progress made in multispecies modelling and in the collection of input data and decide when enough progress has been made to warrant further efforts in this area. Future meetings should focus on assessing modelling results from the Scenario Barents Sea model and possibly the GADGET-based template models for other areas, if they are developed. The Scientific Committee should also consider the feasibility of connecting the multi-species models with simple economic models at that time.

Response of the Scientific Committee:

In progress.

2. ENVIRONMENTAL ISSUES

Code/Meeting: 2.1/NAMMCO/1
Request:

To describe the possible pathways of radioactive material from blowouts and leakage in existing nuclear power plants, leakage from dumped material and possible accidents in planned recycling plants in the northern part of Scotland into the food web of the North Atlantic and hence into the top predators like marine mammals.

Response of the Scientific Committee:

No response.

Code/Meeting: 2.2/NAMMCO/1
Request:

To review the contaminant burdens (especially organochlorines) in marine mammals in the North Atlantic and evaluate the possible sources of these contaminants.

Response of the Scientific Committee:

No response from the Scientific Committee. In 1995, NAMMCO hosted the

International Conference on Marine Mammals and the Marine Environment. The Conference covered the following themes: Marine mammals and the marine environment-impacts and management approaches; Contaminants in marine mammals – sources, levels and effects; Coastal communities and marine pollution – social, economic and health considerations; Addressing the questions – problems and future needs. The proceedings were published as a special issue of *The Science of the Total Environment* (186, 1,2).

3. MANAGEMENT PROCEDURES

Code/Meeting: 3.1/NAMMCO
Request:

To review the basis for, and develop assessments necessary to provide the scientific foundation for conservation and management of the stocks relevant for management under NAMMCO.

Response of the Scientific Committee:

A Working Group on Management Procedures was established to consider this matter. (SC/2). The Scientific Committee noted that there were many different management needs requiring different management procedures. It was agreed that there was need for more guidance on management objectives before any concrete work can be started on developing appropriate management procedures, and in turn this was likely to be case- (species and/or area) specific. Related to this it was also noted that NAMMCO may prefer to assume an advisory and evaluative role in developing its management. (SC/2)

Code/Meeting: 3.2/NAMMCO/4
Request:

Further development of RMP-like procedures.

Response of the Scientific Committee:

The Scientific Committee decided to develop management procedures on a case-by-case basis: "a more pragmatic approach on an area and species/case-specific basis would be desirable for the development of specific management procedures. It was therefore decided to suggest that requests for advice from the Council be accompanied by specific objectives defined for the case in question". (SC/3)

4. STOCKS/SPECIES

Monitoring marine mammal stock levels and trends in stocks /North Atlantic Sightings Surveys (NASS):

Code/Meeting: 4.1/NAMMCO/3
Request:

To plan joint cetacean sighting surveys in the North Atlantic by co-ordinating national research programmes.

Response of the Scientific Committee:

The Scientific Committee agreed to establish a Working Group to plan the sighting survey for the summer of 1995. (SC/2)

The Scientific Committee was pleased to note the good progress that had been made in planning this important joint research, in which the Faroes (1 vessel), Iceland (3 vessels and 1 aircraft) and Norway (11 vessels) had decided to participate. It was noted that Greenland had decided not to conduct surveys as part of these joint efforts. (SC/3)
The Scientific Committee agreed to recommend that a special fund of NOK 800,000 be established from the NAMMCO budget for use in financing various aspects of NASS-95, where required. (SC/3)

Code/Meeting: 4.2/NAMMCO/5
Request:

The 1995 North Atlantic Sightings Survey (NASS-95) would provide updated abundance estimates for a number of whale species in the North Atlantic, and the Scientific Committee was requested to review results in the light of recent assessments of North Atlantic whale stocks.

Response of the Scientific Committee:

The Scientific Committee agreed to establish a Working Group on Abundance Estimates. The task of the Working Group on Abundance Estimates would be to review analyses and where relevant also analyse data from NASS-95 to ensure its compatibility, both between NASS-95 survey areas, as well as with data from other sightings surveys, in order to provide a basis for calculating abundance estimates for the relevant cetacean stocks in the North Atlantic. (SC/4)

Code/Meeting: 4.3/NAMMCO/6
Request:

The Management Committee noted the successful completion of the North Atlantic Sightings Survey in 1995, and commended the process initiated by the Scientific Committee to conclude the analysis of NASS-95 data. It was expected that the results on abundance will be dealt with by the newly established Scientific Committee Working Group on Abundance Estimates and will be presented at the next annual meeting. It was noted that the Working Group would at least to some extent address last year's request from the Council regarding monitoring of stock levels and trends in stocks. However, it was also noted that one outstanding matter from last year is the request to the Scientific Committee to review results of NASS-95 in the light of recent assessments of North Atlantic whale stocks.

The Council agreed to the suggestion from the Management Committee that this be drawn to the attention of the Scientific Committee to secure a follow-up to last year's request.

Response of the Scientific Committee:

To address this request, a Working Group on Abundance Estimates had been established with the task of reviewing the analyses, and where relevant, also to analyse data from NASS-95 to provide a basis for calculating abundance estimates for the relevant cetacean stocks in the North Atlantic. The Working Group had focused on describing synoptic distributions of the cetacean species encountered during NASS-95, and abundance estimates for minke, fin, sei and pilot whales, which were the target species of the survey. The Scientific Committee concluded that the updated abundance

estimates for the target species as reviewed by the Working Group on Abundance Estimates represented the best available estimates for the stocks concerned, and used them as a basis to provide advice to Council. The Scientific Committee also recommended that the results of NASS-95 be compiled to a future volume of *NAMMCO Scientific Publications*. (SC/5)

Code/Meeting: 4.4/NAMMCO/7
Request:

The Scientific Committee was requested to continue its work to monitor stock levels and trends in all stocks of marine mammals in the North Atlantic in accordance with previous recommendations (see *NAMMCO Annual Report 1996*:131-132). In this context the Scientific Committee was encouraged to prioritise calculation of the abundance of species covered by NASS-95, in particular those species presently harvested and species considered to be important with respect to interactions with fisheries.

Response of the Scientific Committee:

See 4.3.

Code/Meeting: 4.5/NAMMCO/9
Request:

NASS-95: The Management Committee noted particularly that abundance estimates from NASS-95 have not been completed for some species. The Management Committee therefore recommended that the Scientific Committee complete abundance estimates for all species, as part of its efforts to monitor the abundance of all species in the North Atlantic.

Response of the Scientific Committee:

The Scientific Committee noted that abundance estimates for the main target species of NASS-95 (minke whale, fin whale, sei whale, pilot whale) had been completed and accepted by them, however most had not yet been published in the primary scientific literature. The Scientific Committee agreed that further analyses of the abundance of non-target species from the NASS-95 survey should be conducted if they are warranted. However, as the survey was not optimised for these species, it was recognised that the design and conduct of the survey would make this possible to a varying degree, depending on both the species and area in question. In some cases, a general description of the spatial distribution of sightings may be the only analysis warranted. The Scientific Committee agreed to pursue these analyses in the coming year. (SC/8)

The Scientific Committee considered new information on the NASS-95 Icelandic aerial and shipboard surveys for minke whales, and a new abundance estimate for humpback whales from the NASS-95 Icelandic shipboard survey. (SC/9)

Code/Meeting: 4.6/NAMMCO/9
Request:

The Management Committee recommended that the Scientific Committee continue its efforts to co-ordinate future sighting surveys and analyses of the results from such surveys in the North Atlantic. Priority species should be minke whales and fin whales, and the Management Committee recommended that that the survey design be

optimised for these species. The survey should also be optimised to cover those areas where abundance estimates are most urgently required.

Response of the Scientific Committee:

The Working Group on Abundance Estimates met in November 2000 to plan for NASS-2001. The survey was conducted in June/July 2001. (SC/9)

Code/Meeting: 4.7/NAMMCO/11

Request:

The Management Committee recommended that remaining abundance estimates from the NASS-95 and new estimates from the NASS-2001 surveys should be developed as soon as feasible, with the target species of the surveys being of highest priority. The Management Committee emphasised that this work should be published in a timely manner.

Response of the Scientific Committee:

The Working Group on Abundance Estimates met in March 2002 and developed preliminary abundance estimates for fin whales, minke whales, humpback whales, sperm whales and dolphins. In addition a full evaluation of the 2001 survey was conducted, and recommendations for future surveys were made. (SC/10).

Central North Atlantic minke whales:

Code/Meeting: 4.8/NAMMCO /7

Request:

In the light of the new survey abundance results the Scientific Committee is requested to undertake an assessment of the status of the Central North Atlantic minke whale stock, including to evaluate the long-term effects of past and present removal levels on the stock.

Response of the Scientific Committee:

The Scientific Committee agreed to assign the task of assessing the status of the stock to the Working Group on Management Procedures. The Council had requested the Scientific Committee to provide its advice on this matter prior to the next meeting of the Council, however it was the general view of the Committee that it was unlikely that this work could be completed within this time frame. (SC/5)

The Scientific Committee used the report of the Working Group on Management Procedures as the basis for providing advice and research recommendations to Council. The Committee agreed that catches of 292 per year (the mean of the catch between 1980-84) are sustainable for the Central stock, and that catches of 185 whales per year are sustainable for the costal (SC/6)

Code/Meeting: 4.9/NAMMCO/8

Request:

In order to ascertain the stock structure of minke whales in the North Atlantic, the Scientific Committee is requested to investigate the possibility of supplementing present sampling with existing older material from NAMMCO countries and other countries in joint genetic analyses. If possible, such analyses should be undertaken.

Response of the Scientific Committee:

It was noted that such exchanges of samples are ongoing between Norway and Greenland. Samples collected in the past from Iceland and Norway have already been analysed concurrently, and there are no recent samples from Iceland. The Scientific Committee concluded that available samples are being utilised effectively. (SC/7)

Code/Meeting: 4.10/NAMMCO/11
Request:

The Management Committee recommended that the Scientific Committee should complete an assessment of Central Atlantic minke whales once new abundance estimates from NASS-2001 become available.

Response of the Scientific Committee:

Response pending.

Northern bottlenose whales:

Code/Meeting: 4.11/NAMMCO/2
Request:

To undertake an assessment of the status of the northern bottlenose whale (*Hyperoodon ampullatus*) stock in the North Atlantic.

Response of the Scientific Committee:

A Working Group on Northern Bottlenose and Killer Whales established, and provided a preliminary assessment which was used as the basis of advice and recommendations for further research given by the Scientific Committee. (SC/2)

Code/Meeting: 4.12/NAMMCO/4
Request:

To undertake the necessary modelling of the species as suggested under ... items 9.2. and 10.2.2 of ...[the Report of the Third Meeting of the Scientific Committee, 1993]. (SC/3)

Response of the Scientific Committee:

A joint session was held of the Working Group on Northern Bottlenose Whales and the Working Group on Management Procedures in order to consider the request from the Council to undertake the necessary modelling of the population using catch series and abundance estimates. Their report was used as the basis for advice and research recommendations conveyed by the Scientific Committee. (SC/3)

Killer whales:

Code/Meeting: 4.13/NAMMCO/2
Request:

To advise on stock identity for management purposes; to assess abundance in each stock area; to assess effects of recent environmental changes, changes in the food supply and interactions with other marine living resources in each stock area.

Response of the Scientific Committee:

A Working Group on Northern Bottlenose and Killer Whales established by the

Scientific Committee, and provided a preliminary assessment. This provided the basis for advice and research recommendations given by the Scientific Committee. (SC/2)
The Chair noted that it had not yet been possible to complete a full assessment of the killer whale as requested by the Council. Few new data were available, other than recent sightings data from NASS-95 which had not been analysed. (SC/5)

Long-finned pilot whales:

Code/Meeting: 4.14/NAMMCO/1
Request:

To provide an assessment of the state of the pilot whale stock in the north eastern Atlantic, based on the information sampled from the Faroese drive fishery and the NASS sighting surveys.

Response of the Scientific Committee:

The Scientific Committee decided to base its advice on the report of the ICES Study Group on Long-Finned Pilot whales. They concluded that an evaluation of status could not be provided without further work.(SC/2)

Code/Meeting: 4.15/NAMMCO/2
Request:

To analyse the effects of the pilot whale drive hunt in the Faroe Islands on North Atlantic pilot whales (*Globicephala melas*), especially whether the numbers taken are consistent with sustainable utilisation.

Response of the Scientific Committee:

This matter was addressed by the Scientific Committee, based on the findings of the ICES Study Group and the review of the results of NASS-95. The Scientific Committee agreed to endorse the list of future research requirements listed by the ICES Study Group in its report, and provided advice on the sustainability of the Faroese catch. (SC/5)

Narwhal and beluga:

Code/Meeting: 4.16/NAMMCO/7
Request:

The Scientific Committee was requested to examine the population status of narwhal and beluga (white whales) throughout the North Atlantic.

Response of the Scientific Committee:

The Scientific Committee established a Working Group on the Population Status of Narwhal and Beluga in the North Atlantic, which met in March 1999. The Scientific Committee used the report of the Working Group to evaluate the stock status of the various narwhal and beluga aggregations, and provided recommendations to Council. (SC/7)

Code/Meeting: 4.17/NAMMCO/8
Request:

The Management Committee requested advice from the Scientific Committee on the level of sustainable utilisation of West Greenland beluga in different areas and under

different management objectives. For narwhal, the Management Committee requested that the Scientific Committee identify the information which is lacking in order to answer the same question proposed with respect to beluga.

Response of the Scientific Committee:

The Scientific Committee reactivated the Working Group on the Population Status of Narwhal and Beluga and used its report as the basis of its recommendations to the Council. The Scientific Committee concluded that the stock is substantially depleted and that present harvests are several times the sustainable yield, and, if continued, will likely lead to stock extinction within 20 years. The Committee assessed a range of harvest options with the overall objective of arresting the decline of West Greenland Beluga, and provided prioritised research recommendations. (SC/8)

The Scientific Committee noted that developing recommendations on the sustainable harvest of narwhal in Greenland will require significant additional research and cannot be done at present. To this end, the Scientific Committee provided research recommendations to answer questions about catch statistics, stock identity and abundance. (SC/8).

Code/Meeting: 4.18/NAMMCO/10

Request:

The Management Committee recommended that the Scientific Committee continue its assessment of West Greenland beluga with reference to the short-term research goals identified. It is anticipated that a joint meeting of the Scientific Working Group of the JCNB and the NAMMCO Scientific Working Group on the Population Status of Narwhal and Beluga in the North Atlantic can be held in spring 2001.

Response of the Scientific Committee:

The Scientific Committee Working Group on the Population Status of Narwhal and Beluga in the North Atlantic met jointly with the Scientific Working Group of the Joint Commission on the Conservation and Management of Narwhal and Beluga (JCNB) to deal with these requests. The Scientific Committee used their report to provide catch options for West Greenland Beluga and research recommendations for West Greenland beluga and narwhal. (SC/9)

Code/Meeting: 4.19/NAMMCO/10

Request:

The Management Committee recommended that the Scientific Committee complete an assessment of narwhal in West Greenland when the necessary data are available. Specifically, the Scientific Committee is requested to evaluate the extent of movements of narwhal between Canada and Greenland.

Response of the Scientific Committee:

See 4.16. The Scientific Committee used evidence from genetic and contaminant analysis, satellite tagging and hunter knowledge to evaluate the extent of movement between Greenland and Canada. (SC/9).

Code/Meeting: 4.20/NAMMCO/11

Request:

The Management Committee recommended that the Scientific Committee should

concentrate its assessment efforts on the West Greenland narwhal in the near term.

Response of the Scientific Committee:

Response pending.

Code/Meeting: 4.21/NAMMCO/12

Request:

The Management Committee noted that a new survey of West Greenland beluga will be conducted in 2004. The Scientific Committee was therefore requested to update the assessment of West Greenland Beluga in light of the new survey results and any other new information. The main management objective is to halt the decline of this stock.

Response of the Scientific Committee:

Response pending.

Harbour porpoises:

Code/Meeting: 4.22/NAMMCO/7

Request:

The Council noted that the harbour porpoise is common to all NAMMCO member countries, and that the extent of current research activities and expertise in member countries and elsewhere across the North Atlantic would provide an excellent basis for undertaking a comprehensive assessment of the species throughout its range. The Council therefore requested the Scientific Committee to perform such an assessment, which might include distribution and abundance, stock identity, biological parameters, ecological interaction, pollutants, removals and sustainability of removals.

Response of the Scientific Committee:

The Scientific Committee decided that the matter could best be dealt with by convening an international workshop/symposium on harbour porpoises, which would involve experts working on this species throughout its North Atlantic range. The agenda would include the following themes: distribution, abundance and stock identity; biological parameters; ecological interactions; pollutants; removals and sustainability of removals. (SC/6)

The Scientific Committee utilised the report of the Symposium to develop its own assessment advice to the Council. Recent abundance estimates are available for only a few places in the North Atlantic. Directed harvesting occurs in some areas, but most removals are through by-catch. In some areas, present removals are not sustainable. The Scientific Committee developed research recommendations to address some of the information needs for management of this species. (SC/8)

Atlantic walrus:

Code/Meeting: 4.23/NAMMCO/2

Request:

To advise on stock identity for management purposes; to assess abundance in each stock area; to assess long-term effects on stocks by present removals in each stock area; to assess effects of recent environmental changes (i.e. disturbance, pollution) and changes in the food supply.

Response of the Scientific Committee:

The assessment was postponed pending report of Walrus International Technical and Scientific Committee (WITS). (SC/2) It was decided in late 1994 to request Erik Born of the Greenland Fisheries Research Institute in Copenhagen to co-ordinate the compilation of a status report on the Atlantic walrus in time for the present Scientific Committee meeting. The result of this collaboration was the report, E.W. Born, I. Gjertz and R.R. Reeves, "Population assessment of Atlantic walrus (*Odobenus rosmarus rosmarus*)" This report was used by the Scientific Committee as the basis of its management and research recommendations to Council. (SC/3)

Harp and hooded seals:

Code/Meeting: 4.24/NAMMCO/2

Request:

- to assess the stock size, distribution and pup production of harp seals in the Barents Sea and White Sea, and of harp and hooded seals in the Greenland Sea and the Northwest Atlantic;
- to assess sustainable yields at present stock sizes and in the long term under varying options of age composition in the catch;
- to provide advice on catch options in the White Sea/Barents Sea/Greenland Sea and NAFO areas;
- to assess effects of recent environmental changes or changes in the food supply and possible interaction with other living marine resources in the areas.

Response of the Scientific Committee:

- These requests forwarded to Joint ICES/NAFO Working Group on Harp and Hooded Seals. A partial assessment was completed, but more work was required. (SC/2)
- The Scientific Committee considered the report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals which had met in Dartmouth, Canada, 5-9 June 1995. The Scientific Committee endorsed the recommendations in the report and identified further research needs. However the required assessments had not yet been completed. (SC/4).
- The Scientific Committee considered the report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals which had met in Copenhagen in 1997. The Scientific Committee used this report as the basis for its advice to Council, while noting that catch options had not been completed for Greenland Sea harp and hooded seals, and White Sea and Barents Sea harp seals. (SC/6)
- The Joint ICES/NAFO Working Group on Harp and Hooded Seals met in 1998 to complete the assessments for Greenland Sea harp and hooded seals, and White Sea and Barents Sea harp seals. The Scientific Committee used their report as the basis of its advice to Council, and noted that the required assessments had now been completed. Assessment of the effects of recent environmental changes or changes in the food supply and possible interaction with other living marine resources in the areas is ongoing. (SC/7)

Code/Meeting: 4.25/NAMMCO/8

Request:

The Scientific Committee is requested to co-ordinate joint feeding studies of harp and

hooded seals in the Nordic Seas (Iceland, Greenland and Norwegian Seas) and off West Greenland.

Response of the Scientific Committee:

The Scientific Committee noted that preparations to co-ordinate such studies between member countries were already under way, outside of the NAMMCO Scientific Committee. The Scientific Committee therefore emphasised its support for such joint studies and urged member countries to participate. (SC/7)

Code/Meeting: 4.26/NAMMCO/11

Request:

The Management Committee recommended that the Scientific Committee regularly update the stock status of North Atlantic harp and hooded seal stock as new information becomes available.

Response of the Scientific Committee:

Ongoing as new information becomes available.

Code/Meeting: 4.27/NAMMCO/12

Request:

The Management Committee noted that new information recently had become available on the abundance of harp seals in the Greenland Sea and the Northwest Atlantic. In addition new information is available on movements and stock delineation of harp seals in the Greenland, Barents and White seas. The Management Committee therefore reiterated its previous request to the Scientific Committee to regularly update the stock status of North Atlantic harp and hooded seals as new information becomes available. The Management Committee noted the likely impact of increasing abundance of these species on fish stocks. For harp seals in the Northwest Atlantic, the immediate management objective is to maintain the stocks at their present levels of abundance.

Response of the Scientific Committee:

Ongoing as new information becomes available.

Ringed seals:

Code/Meeting: 4.28/NAMMCO/5

Request:

To advise on stock identity of ringed seals (*Phoca hispida*) for management purposes and to assess abundance in each stock area, long-term effects on stocks by present removals in each stock area, effects of recent environmental changes (i.e. disturbance, pollution) and changes in the food supply, and interactions with other marine living resources.

Response of the Scientific Committee:

The Scientific Committee established a Working Group on Ringed Seals. The Scientific Committee considered the report of the Working Group and provided advice to Council. They also provided recommendations for future research. (SC/5) Papers considered by the Working Group as well as other papers were published in the first volume of NAMMCO Scientific Publications, *Ringed Seals in the North Atlantic*.

Code/Meeting: 4.29/NAMMCO/7
Request:

The Scientific Committee was requested to advise on what scientific studies need to be completed to evaluate the effects of changed levels of removals of ringed seals in West and East Greenland.

Response of the Scientific Committee:

It was noted that the exploitation level of ringed seals in Greenland has shown considerable variability over decades in this century. The Scientific Committee chose to focus on scenarios where exploitation is raised by more than twice the level reported in recent years. The Scientific Committee then identified the main gaps in knowledge, and recommended research required to address them. (SC/6)

Grey seals:

Code/Meeting: 4.30/NAMMCO/5
Request:

To review and assess abundance and stock levels of grey seals (*Halichoerus grypus*) in the North Atlantic, with an emphasis on their role in the marine ecosystem in general, and their significance as a source of nematodal infestations in fish in particular.

Response of the Scientific Committee:

The Scientific Committee established a Working Group on Grey Seals. The Scientific Committee considered the report of the Working Group and provided advice to Council, including recommendations for further research. (SC/4)

Code/Meeting: 4.31/NAMMCO/11
Request:

The Management Committee noted that there has been a decline in the numbers of grey seals around Iceland, possibly due to harvesting at rates that are not sustainable. The Scientific Committee had previously provided advice in response to a request to review and assess abundance and stock levels of grey seals in the North Atlantic, with an emphasis on their role in the marine ecosystem in general, and their significance as a source of nematodal infestations in fish in particular (NAMMCO 1995). Given the apparent stock decline in Iceland, an apparent increase in Southwest Norway and in the United Kingdom, and the fact that this species interact with fisheries in three NAMMCO member countries, the Management Committee recommended that the Scientific Committee provide a new assessment of grey seal stocks throughout the North Atlantic.

Response of the Scientific Committee:

Response pending. The Working Group on Grey Seals will meet in April 2003.

Dolphin species *(Tursiops* and *Lagenoryhncus spp.):*

Code/Meeting: 4.32/NAMMCO/7
Request:

The Council recommended that NAMMCO member countries study the ecological

interaction between dolphin species (e.g., *Lagenorhynchus spp.*) and fisheries, with the view to future assessments of such interactions.

Response of the Scientific Committee:

Not addressed due to insufficient information.

Code/Meeting: 4.33/NAMMCO/8

Request:

Noting that ecological interactions between dolphin species of the *Lagenorhynchus* genus and fisheries have caused concern in NAMMCO countries, the Scientific Committee is requested to perform an assessment of distribution, stock identity, abundance and ecological interactions of white-beaked and white-sided dolphins in the North Atlantic area.

Response of the Scientific Committee:

The Scientific Committee noted that the IWC Scientific Committee had dealt with these species in 1996. Generally, it was considered that there is insufficient information on stock structure, abundance and feeding ecology to carry out a meaningful assessment of these species at this time. Some new information on abundance may become available from the NASS-95 survey, but these data have not yet been analysed. The Scientific Committee agreed to begin compiling available information on these species in member countries, with the objective of identifying knowledge gaps and creating a basis for assessment in the longer term. (SC/7)

Code/Meeting: 4.34/NAMMCO/9

Request:

At its Eighth Meeting in 1998, the Council agreed to the recommendation of the Management Committee to request the Scientific Committee to perform an assessment of distribution, stock identity, abundance and ecological interactions of white-beaked and white-sided dolphins in the North Atlantic area. The Management Committee noted the conclusion of the Scientific Committee that there is insufficient information on stock structure, abundance and feeding ecology to carry out a meaningful assessment of these species at this time. The Management Committee further noted that, in addition to the focus of the Management Committee's former request for advice on these species in relation to their ecological interactions with fisheries, these dolphin species are harvested in significant numbers in the Faroe Islands. The Management Committee therefore agreed to recommend that the Scientific Committee be requested to facilitate the requested assessment of these species, with an emphasis on the following:

to analyse results from NASS 95 and other sightings surveys as a basis for establishing abundance estimates for the stocks; to co-ordinate the efforts of member countries to conduct research to fill the noted information gaps, taking advantage in particular of the sampling opportunities provided by the Faroese catch, as well as dedicated samples in other areas.

Response of the Scientific Committee:

The Scientific Committee noted that the NASS surveys were optimised for species other than dolphins, and that in some cases, it was not possible to identify dolphins to species. In these cases, mapping of sightings may be the only analysis warranted. Further analyses may be feasible from the Faroese and Icelandic survey areas, and the

Scientific Committee made preparations to begin these analyses.

These species are harvested sporadically in drive hunts in the Faroe Islands, and there is some by-catch in Iceland. They are rarely taken in Norway or Greenland. Scientific papers on feeding ecology and life history in Icelandic waters are expected to be published soon. The Scientific Committee recommended that a sampling program be initiated in the Faroe Islands for white-sided, white-beaked and bottlenose dolphins, primarily to collect information on feeding ecology, life history and stock delineation. They also recommended that sampling should continue in Iceland and Norway on an opportunistic basis.

Code/Meeting: 4.35/NAMMCO/9
Request:

The Management Committee noted that bottlenosed dolphins, like white-sided and white-beaked dolphins, are also harvested in the coastal drive fishery in the Faroe Islands. The Management Committee agreed to recommend that, in connection with the updated request for advice from the Scientific Committee on white-sided and white-beaked dolphins, that bottlenosed dolphins also be included in this assessment

Response of the Scientific Committee:

See 4.34

Code/Meeting: 4.36/NAMMCO/10
Request:

The Management Committee noted that the requested assessments for these species could not at present be completed because of a lack of information on stock identity, distribution, abundance and biology. The Management Committee therefore recommended that the Scientific Committee monitors developments in this area and continues its assessments, as new data become available.

Response of the Scientific Committee:

To be completed as new information becomes available.

Fin whale:

Code/Meeting: 4.37/NAMMCO/8
Request:

The Scientific Committee is requested to undertake an assessment of the status of fin whales in the North Atlantic based on all available data. (This request was later elaborated as follows: "Acknowledging the large amount of work involved in such a comprehensive assessment of all possible fin whale stocks in the North Atlantic, the Council requests the Scientific Committee, when conducting such comprehensive assessment, particularly to:
- assess the stock structure of fin whales in the whole North Atlantic.
- assess the long-term effects of annual removal of 50, 100 and 200 fin whales in the stock area traditionally assumed to have a main concentration off East Greenland and Iceland (EGI stock area),
- identify MSY exploitation levels for that stock area.")

Response of the Scientific Committee:

The Scientific Committee established a Working Group on Fin Whales to deal with this request. The Working Group met in April 1999. Their report dealt with the stock structure of fin whales throughout the North Atlantic, and with assessment of the EGI stock. The Scientific Committee used the report of the Working Group to formulate advice and research recommendations to NAMMCO Council. Detailed assessment of other fin whale stocks was not carried out, but will be if further requests from Council are forthcoming.

Code/Meeting: 4.38/NAMMCO/9
Request:

The Management Committee noted that the Scientific Committee has completed its assessment of the stock structure of fin whales in North Atlantic, and that more research on stock structure is required before firm conclusions can be drawn. The Management Committee therefore recommended that member countries initiate the research required to elucidate the stock structure of fin whales.
The Management Committee recommended that the Scientific Committee continue its assessment of fin whale stocks in the North Atlantic, focussing in the near term on the status of fin whales in Faroese territorial waters. The Scientific Committee should focus particularly on the following issues:
- Assess the long-term effects of annual removals of 5, 10 and 20 fin whales in Faroese waters;
- Information gaps that may need to be filled in order to complete a full assessment in this area.

Response of the Scientific Committee:

The Scientific Committee reactivated the Working Group on North Atlantic Fin Whales and used their report as the basis for their advice to the Council. The results of the assessments indicated that fin whales in the area have likely been substantially depleted by past harvests, but there was great uncertainty in the results. The Scientific Committee noted that in attempting to respond to the Council's request for advice on the long-term effect of various catch levels in the Faroese area, it had immediately become apparent that there is insufficient information on stock identity to carry out a reliable assessment of the status of fin whales in Faroese waters, and thus provide reliable advice on the effects of various catches. The Scientific Committee therefore recommended a research program primarily geared to understanding the stock relationships of fin whales around the Faroes.

Code/Meeting: 4.39/NAMMCO/10
Request:

The Management Committee noted that the requested assessment (see 4.38) had not been fully completed and awaited in particular the provision of more information on stock delineation. The Management Committee therefore recommended that the Scientific Committee continue its assessment, as new data become available.

Response of the Scientific Committee:

To be addressed as new information becomes available.

Code/Meeting: 4.40/NAMMCO/11
Request:

The Management Committee clarified its previous request for advice on fin whales, asking that the Scientific Committee continue with its assessments of fin whale stocks in the areas of interest to NAMMCO countries with existing and new information on abundance and stock delineation as it becomes available.

Response of the Scientific Committee:

Response ongoing as information becomes available. The Working Group on Fin Whales will meet in September 2003.

Humpback whale:

Code/Meeting: 4.41/NAMMCO/11

Request:

The Management Committee noted the conclusions of the Scientific Committee that there was evidence of a rapidly increasing abundance of humpback whales around Iceland, and recommended that the Scientific Committee complete abundance estimates for this species as a high priority. The Scientific Committee should also consider the results of the "Years of the North Atlantic Humpback" (YoNAH) project as it pertains to member countries in providing advice for this species.

Response of the Scientific Committee:

Response pending. Abundance estimates will be finalised in 2003. Information from the YoNAH project, pertaining to stock delineation, migration, biological parameters, and abundance both North Atlantic-wide and in feeding areas has been published. The Scientific Committee has noted previously (SC/9) that abundance estimates from the NASS-95 survey appear to conflict with the results of the YoNAH project, and comparison with the estimates from NASS-2001 should be of great interest. (SC/10)

5. OTHER

Code/Meeting: 5.1/NAMMCO/8

Request:

Greenland noted the need for greater input from hunters and users in the work of the Scientific Committee. While noting the need for scientists to be able to conduct their work on their own scientific terms in the context of their Committee meetings, it was suggested that scientists and users of marine mammal resources which are the subject of examination by the Scientific Committee could, for example, meet prior to meetings of the Scientific Committee in order to exchange information relevant to the work planned by the Scientific Committee. With these ideas in mind, Greenland recommended that concrete steps should be taken to provide for a more active dialogue between scientists and resource users. This recommendation was endorsed by Council.

Response of the Scientific Committee:

The Scientific Committee agreed to consider a proposal put forward by the Secretariat, to use the “Status of Marine Mammals in the North Atlantic” stock status reports as a means of incorporating the knowledge of marine mammal users. This proposal will be presented to NAMMCO Council for approval. (SC/7)

The Scientific Committee Working Group on the Population Status of Narwhal and

Beluga in the North Atlantic met jointly with the Scientific Working Group of the Joint Commission on the Conservation and Management of Narwhal and Beluga (JCNB) in May 2001. Prior to the main meeting, the Joint Working Group met with hunters from Greenland and Canada, and Canadian hunters participated throughout the meeting. (SC/9)

Code/Meeting: 5.2/NAMMCO/9
Request:

With respect to the language used in the Report of the Scientific Committee, Greenland suggested that it must be kept precise and simple. The Management Committee agreed to convey this as a suggestion to the Scientific Committee.

Response of the Scientific Committee:

No response.

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2.2
REPORT OF THE MANAGEMENT COMMITTEE WORKING GROUP ON BY-CATCH

Teleconference 17 February 2003

Chairman Kim Mathiasen (Greenland) welcomed the participants to the meeting: Dr Arne Bjørge (Norway), Mr Elling Lorentsen (Norway), Mr Bjarni Mikkelsen (Faroe Islands), Mr Jens Dam (Faroe Islands), Ms Droplaug Ólafsdóttir (Iceland) and Mr Daniel Pike (NAMMCO).

1. Adoption of agenda

The draft agenda (Appendix 1) was adopted without change.

2. Appointment of rapporteur

Daniel Pike, Scientific Secretary of NAMMCO, was appointed as rapporteur for the meeting.

3. Information regarding ongoing monitoring and management of marine mammal by-catches outside the NAMMCO Area

3.1 European Union Initiative

Last year the Working Group recommended that Norway continue to report on the "European Initiative" in bycatch monitoring and reduction to NAMMCO through this Working Group. Bjørge informed the Working Group that a Nordic Co-ordination meeting will be held in advance of the ASCOBANS meeting in April, at which time progress in bycatch monitoring and reduction within the European Union will be discussed. Until that meeting takes place, little new information will be available. Bjørge agreed to send a written report to the Working Group immediately after the Nordic Co-ordination meeting, sometime in March 2003.

4. Review progress in monitoring and management of marine mammal by-catches within the NAMMCO Area

4.1 Progress in monitoring marine mammal by-catches by NAMMCO Member Countries

Mathiasen reported that **Greenland** had taken no new initiatives with regard to bycatch in 2002. There is a system of mandatory reporting of marine mammal bycatch through logbooks kept by all fishing vessel operators. National inspectors observe on larger vessels operating offshore. In addition a Wildlife Officer must be informed of any incident involving the entanglement of a marine mammal in fishing gear. In 2001 no bycatch was reported through the logbooks, and it is not known if this represents an absence of bycatch or a lack of reporting. The incidents of humpback whale entanglement (see 5.2) were reported to a Wildlife Officer.

Bjørge reported that the reporting of marine mammal bycatch through fishery logbooks was now mandatory in **Norway.** However, the logbook information is also being supplemented through other measures. Independent fishery observers are used on a sub-sample of the offshore fishing fleet, and their observations will be scaled up

to estimate total bycatch in the respective fisheries. Further, a “reference fleet” is being established, which will be a sub-sample of vessels from which very detailed effort and bycatch data will be collected. Methods for collecting bycatch data from small coastal vessels (Sjark) are still under development. It is expected that the new system will begin to return useable data within the next few months. The emphasis is now directed towards the entire Norwegian fishing fleet, and not only focused on the fisheries of anticipated by-catches of marine mammals. The reason for this is that documentation of "clean fisheries" is anticipated to be prerequisite for "environmental labelling" of fish products.

Mikkelsen noted that there had been no recent changes in the bycatch reporting system for the **Faroe Islands**. Reporting of marine mammal bycatch in fishery logbooks is mandatory for mid- to large size vessels. At present there is no reporting system for small coastal vessels. Faroese observers are present on international exploratory fisheries (*e.g.* for tuna) and report any bycatch that occurs. Mikkelsen was unsure about the status of bycatch reporting on foreign vessels fishing in Faroese waters, and agreed to look into this matter for the Working Group.

Olafsdóttir noted that the reporting of marine mammal bycatch has been mandatory in **Iceland** for some years, but a systematic effort on reporting and compiling marine mammal by-catch was first initiated in the beginning of 2002. All fishermen using gill nets were sent a letter from the Directorate of Fisheries explaining the procedure of reporting the bycatch through fishery logbooks. Fisheries inspectors from the Directorate of Fisheries have furthermore explained the procedure during regular visits to the boats.

Preliminary results from 2002 indicate that about 5% of the vessels participating in the gillnet fishery returned reports in which bycatch information was recorded, and in these reports bycatch was recorded in about 8% of the nets that were set. However a small proportion of these vessels accounted for most of the reported bycatch. Eight species of marine mammals were caught, of which harbour porpoises and harbour seals where the most common species. The relatively low proportion of vessels that returned records indicates that the real bycatch may be much higher than that recorded. Even those that did report bycatch seemed to do so sporadically and furthermore, records form certain areas were completely missing.

From the beginning of 2003 the entire fishing fleet will receive instructions of reporting marine mammal by-catch with each fishery logbook the boats will receive from The Directorate of Fisheries, including all large vessels as well as the gill net boats. No further plans have been made to improving the progress of monitoring marine mammal by-catch in Iceland.

4.2 Evaluation of procedures developed and implemented by NAMMCO Member Countries

In 2002 the Working Group considered that procedures for the monitoring of bycatch in NAMMCO member countries had not yet reached a stage of implementation where an evaluation could be conducted. The Working Group concluded that this was still

the case, and that at least another year would be required before the systems in Norway and perhaps Iceland were at a stage where a useful evaluation could be conducted. However it was recommended that such an evaluation should be conducted at the earliest possible opportunity.

5. Reporting of bycatch to NAMMCO

5.1 Use of National Progress Reports to report bycatch.

In 2002 the Working Group recommended that the format of the National Progress reports should be changed such that the reports discriminated between no bycatch, and an apparent lack of bycatch because of inadequate monitoring. It was also recommended that the Reports should include a brief explanation of how bycatch information was collected, including the methodology used (*e.g.* log book, observers, questionnaires), the fisheries covered and the extent of the coverage by fishery, and should be adequate for a future evaluation of bycatch monitoring procedures by the Scientific Committee and/or this Working Group.

Pike reported that the format had been modified, mainly through the addition of a narrative introduction to the bycatch section, in which the monitoring programs would be fully described. Member countries had been instructed to use the new format for the preparation of National Progress Reports for 2001. The Working Group reviewed the new format and found it acceptable.

5.2 Reporting in 2001

Pike reviewed the bycatch information in the National Progress Reports for 2001. Norway did not use the revised format and hence did not report bycatch. The Faroe Islands used the revised format and reported a bycatch of 1 bottlenose whale. Greenland reported a bycatch of 2 humpback whales in the year 2000. However the report was incomplete and no details about monitoring methodology and coverage, fishery or gear type were given. Iceland reported that no systematic reporting of by-caught marine mammals took place in 2001, but that information would be available for 2002 (see 4.1).

In the discussion the Working Group noted the continued lack of adequate reporting by some member countries and reiterated its recommendation from 2002 for member countries to report their bycatch to NAMMCO through the new National Progress Report format.

6. Other items

Mathiasen reported that there had been an increase in the number of large cetaceans entangled in fishing gear in West Greenland in recent years. In some cases these animals are still alive when found and are killed by the fishermen. He noted that this might be a matter of concern to NAMMCO, both in terms of total allowable catch and the methods by which these animals are killed.

The Working Group noted that similar incidents may occur with small cetaceans and pinnipeds in other areas as well as Greenland. The Working Group agreed to bring this

matter to the attention of the Management Committee, particularly with regard to the killing methods employed in large whale entanglements.

7. Recommendations

The Working Group, noting that the reporting of bycatch to NAMMCO was still not adequate, reiterated its recommendation from 2002, that NAMMCO member countries report their bycatch to NAMMCO through the new National Progress Report format.
As soon as one member country has a functioning bycatch monitoring system in place, the Working Group should meet to conduct a full evaluation of the system and make recommendations on bycatch monitoring to all member countries. The evaluation should focus on the practical and logistical aspects of the reporting system. It was anticipated that this could be done within the next 12 to 24 months.

8. Further meetings?

The Working Group considered that annual teleconferences should be adequate until the evaluation mentioned under 7.ii. can be conducted.

9. Adoption of report

The report was adopted by correspondence on 25 February, 2003.

Appendix 1

AGENDA

1. Adoption of Agenda
2. Appointment of Rapporteur
3. Information regarding ongoing monitoring and management of marine mammal by-catches outside the NAMMCO Area
   - 3.1 European Union Initiative
4. Review progress in monitoring and management of marine mammal by-catches within the NAMMCO Area
   - 4.1 Progress in monitoring marine mammal by-catches by NAMMCO Member Countries
   - 4.2 Evaluation of procedures developed and implemented by NAMMCO Member Countries
5. Reporting of bycatch to NAMMCO
   - 5.1 Use of National Progress Reports to report bycatch.
   - 5.2 Reporting in 2001.
6. Other items
7. Recommendations
8. Further meetings
9. Adoption of report.

2.3
REPORT OF THE MEETING OF THE MANAGEMENT COMMITTEE ON INSPECTION AND OBSERVATION

Copenhagen, Denmark, 31 January 2003

The Management Committee on Inspection and Observation met in the Office of the Faroe Islands Government in Copenhagen, 31 January from 09:00 - 1300. Present were Egil Ole Øen, chair, (Norway), Jústines Olsen (Faroe Islands), Kristjan Loftsson (Iceland), Amalie Jessen and Kim Mathiasen (Greenland), Grete Hovelsrud-Broda and Charlotte Winsnes from the Secretariat.

1. Election of Chair

Egil Ole Øen was elected as chair of the Committee.

2. Adoption of the Agenda

The agenda was adopted with the following amendment: Item 4. Terms of Reference.

3. Appointment of Rapporteur

Charlotte Winsnes was appointed as rapporteur.

4. Terms of Reference

This was the first meeting of the Committee since it was formally constituted at the Management Committee meeting in Ilulissat in February 2002.

Terms of Reference for the Committee:
The working group shall function as a standing review body to monitor the implementation of the Observation Scheme and provide recommendations for improvements.

- The working group shall upon request from the Secretariat provide advice on the Observation Scheme.
- The Working Group shall report annually to the Management Committee
- The Terms of Reference is open for future adjustments and additions.

The Committee reviewed the terms of reference and agreed on the following understanding:

The Committee is free to discuss and make recommendations for improvements /alterations to the Inspection and Observation Scheme whenever it sees a need for this. If more background information is needed in a given case, it is the responsibility of the Committee to ask the Secretariat to provide all necessary information.

The Committee will function as an advisory body for the Secretariat. If the Secretariat seeks the advice of the Committee it is the responsibility of the Secretariat to provide all necessary background information.

The Committee will not intervene in the daily operation of the Scheme.

5. Experiences with the Inspection and Observation Scheme

The Secretariat had prepared the document NAMMCO/IO-1/2003-4, outlining its experiences with the Observation Scheme. The document was two-fold, and part one gave statistical data such as where and for which period observations have taken place, observation targets, and land of origin of the observers.

The Scheme came into force in 1998 and has been in operation for five seasons. No violation of national or hunting related regulations has occurred during these five seasons. In 2001 there was a violation of the regulations laid down by the NAMMCO Inspection and Observations Scheme when the observer was denied access to one vessel in Norway. However, the national inspector reported no infringements or violations of the Norwegian laws and regulations on the same vessel.

Except for the seasons 1998 and 2002, observations have taken place in the three member countries engaged in hunting activities (the Faroe Islands - pilot whaling, Norway - sealing and minke whaling and Greenland - sealing and whaling). In 1998 observations did not take place in the Faroe Islands, and in 2002 there was no observation of sealing in Norway.

The Committee noted that as a rule the observation period referred to should be the active observation period excluded travelling time to and from the country in question.

Part two of the document NAMMCO/IO-1/2003-4, summarised earlier recommendations made by the Working Group on Inspection and Observation in 1999, in addition to some points made by the Secretariat. Most of the recommendations have for various reasons not been followed up, but it was the general consensus that given a relatively small effort most of the problems could be solved.

The Committee noted that the procedures governing the nomination and appointment of observers might seem somewhat time-consuming and bureaucratic. It is however very important that these procedures are followed in order to secure the legitimacy of the process. The member countries have mainly been the "weak point" here, but this seems to have changed based on the experiences so far related to the upcoming season.

The Committee recommended that the Secretariat produce a one- page information sheet describing the Inspection and Observation Scheme and NAMMCO in general. The information must be translated into all NAMMCO languages, and will be used both by the Secretariat, the member countries and the observers. It will mainly be aimed at the local authorities and hunters but also at the general public. It seems to be a general problem that the Scheme is not as well known as was anticipated. The Committee also recommended that information on the Scheme be placed on the NAMMCO web site.

The Committee recommended that each member country provides the Secretariat with detailed information on hunting statistics, quotas and time frames and places for the most optimum areas of observation, and names of contact persons in each region. As a

routine the Secretariat will be responsible for reminding the member countries to provide this information.

In the future the Secretariat will send the observers' report to the country in question for comments. This condition is outlined in provision B2.4 of the Scheme, but has not been followed up by the Secretariat.

In connection with the 2002 season, one observer reported that based on his interpretation of the Scheme as to when observation can take place, he chose not to submit a report in two cases. After having consulted the guidelines and read the observers report the Committee concluded that the guidelines are not ambiguous on this point and the observer was in a situation where observations could have taken place. In the future, as part of the preparation process, observers should be instructed to seek advice from the Secretariat if they have questions about the provisions of the Scheme or its guidelines.

The remaining points in document NAMMCO/IO-1/2003-4 were dealt with under the next agenda item.

6. The future of the Inspection and Observation Scheme

The Committee agreed that the Inspection and Observation Scheme is working according to the intentions laid down in the provisions of the Scheme. It is important to realise that the Scheme is still "young" and it is therefor too early to fully evaluate the Scheme. The Secretariat's routines for implementation are in place. The problems encountered in the past with this part of the Scheme were mainly related to member countries failing ability to meet deadlines, but this seems to be functioning now. Furthermore, when the observers are out in the field, it is the Committee's impression that the Scheme is working well. In general after having discussed the experiences under item 5., the Committee sees no serious obstacles as to upgrading the routines and making the implementation process run more smoothly.

The Committee underlined that NAMMCO in fact is the only organisation that has a well functioning international Inspection and Observation Scheme on whaling and sealing. However, in order to further strengthen the Scheme the Committee asked the Management Committee to consider the following:

- To increase the budget. In order to fully accomplish the intentions laid down in the Scheme it is necessary with a larger budget. Today the active observation periods have been maximum three weeks, but usually between 8 to 14 days. This is a comparatively short period of time. It has also been the pattern to place one observer in Greenland and the Faroe Islands each and two observers in Norway.

- in some years, to focus the observations on one activity and/or one region. This is not intended to be the rule, but to help expand the experience in a field, given the present budget level.

- to recommend the member countries to nominate more than one observer candidate. The last years there has been a tendency for some member countries to nominate only one candidate. This makes the implementation difficult and very fragile, but also decreases the possible observation periods, places and focuses. It is therefore important to increase the pool of observers, and in that connection remind member countries that it is possible to nominate candidates coming from countries outside of NAMMCO.

7. Any other business

The Chair thanked the Committee members and secretariat for their efforts and especially thanked the Faroe Islands for their kind hosting of the meeting of the Committee.

8. Adoption of the Report

The final report of the meeting was approved by correspondence on 18 February 2003.

SECTION 3 - SCIENTIFIC COMMITTEE

3.1
REPORT OF THE TENTH MEETING OF THE NAMMCO SCIENTIFIC COMMITTEE

EXECUTIVE SUMMARY

The tenth meeting of the NAMMCO Scientific Committee was held 17-19 September at the whaling station at Hvalfjörður, Iceland.

Modelling marine mammal - fisheries interactions in the North Atlantic
At its 8th meeting, the NAMMCO Council tasked the Scientific Committee with providing advice on the economic aspects of marine mammal-fisheries interactions. A Working Group on the Economic Aspects of Marine Mammal - Fisheries Interactions met in February 2000 to consider parts of the request. One of the conclusions of the Working Group was that significant uncertainties remain in the calculation of consumption by marine mammals, and this uncertainty was the most important factor hindering the development of models linking consumption with fishery economics (NAMMCO 2001). Considering this conclusion, the Scientific Committee decided to convene a workshop to further investigate the methodological and analytical problems in estimating consumption by marine mammals. This workshop was held in Tromsø in September 2001 and resulted in, among other things, a list of research priorities to refine existing estimates of consumption by North Atlantic marine mammals (NAMMCO 2002).

The Scientific Committee viewed the next logical step in this process to be a review of how presently available ecosystem models can be adapted in order to increase our understanding of and quantifying marine mammal - fisheries interactions. The Workshop was held in Reykjavik in September 2002. It was tasked with choosing a preferred modelling approach for analysing the ecological role of minke whales, harp and hooded seals, and other marine mammal species in the North Atlantic, identifying required input data, and recommending a process for further development. The Working Group was not expected to review results or make quantitative predictions at the meeting, but rather to focus on methodological problems.

Available multi-species models
The Working Group considered descriptions of the range of available multi-species modelling tools. This includes two general classes of models typified by the Minimum Realistic Models (MRM) on the one hand and the ECOSIM/ECOPATH approach on the other. The MRM class includes MULTISPEC, BORMICON/GADGET and Scenario Barents Sea. These models share the characteristics of being system specific, modelling only a small component of the ecosystem for a specific purpose, and treating lower trophic levels and primary production as constant or varying stochastically. In contrast, ECOPATH/ECOSIM is an all-inclusive approach that incorporates lower trophic levels and primary production. Mass balance equations are used, essentially relating production by some species to predation by others under the assumption that the system is in a steady state. ECOSIM builds upon this approach, but drops the equilibrium assumption so that the system is modelled by a set of

coupled differential equations. Potentially ECOSIM, like the MRM class of models, could provide a basis to provide advice on marine mammal-fisheries interactions.

Recommended modelling approach for NAMMCO

Considering the data available or likely to become available in the foreseeable future, the Working Group favoured the approach of using a limited model that encompassed only the major species of interest, as opposed to an all-encompassing model where all or most species are included, as a basis for potential management advice in the short to medium term. This approach can be described as a Minimum Realistic-type model, as exemplified by Scenario Barents Sea, MULTSPEC and BORMICON. Other components of the ecosystem that are not explicitly modelled, such as primary production or zooplankton, could be left as constant, allowed to vary randomly or linked to environmental covariates.

The Working Group considered that the ECOPATH/ECOSIM package, while providing a viable framework for some types multi-species modelling, was not entirely suited to the usage envisioned by NAMMCO. Potential disadvantages discussed included the in-built functional forms for species interactions, and simplified treatment of age-structure, that may not be appropriate for the particular cases to be considered. Another problem is the large number of parameter values that need to be specified; some of these may have an appreciable impact on outputs, and the default suggestions provided by the package may not be the most appropriate in all circumstances.

Some members voiced the concern that the development of ecosystem models without sufficient data in some components would produce results that might be used inappropriately by managers, who might not understand the level of uncertainty in the results even if it is specified. However it was agreed that the two activities should proceed simultaneously: that is, the data gaps identified should be filled by dedicated studies, while modelling can proceed in candidate areas, even with partial data, as long as the uncertainty of the results is emphasised and integrated in the results. In this way, modelling approaches can be refined and the reliability of the results will improve as more data is gathered.

There was agreement that the continued development of the Scenario Barents Sea model should be a priority, with emphasis on incorporating the predation of harp seals in the model. In addition the Working Group recommended the development of a second, more general North Atlantic "template" model based on the GADGET platform. This spatially homogeneous model would include species important in candidate applications to West and East Greenland, Iceland and the Barents and North Seas. However the abundance of these species would be varied between the areas according to available information. In areas where data is lacking, such as West Greenland, the main use of such a model will be to identify the sensitivities to variation in input parameters, and thus to assist in the setting of priorities for research. In Icelandic waters, where better data is available for fish but data on marine mammal diets and prey selection are scarce, such a model will serve the same purpose but also generate preliminary scenario results for management. For the relatively data-rich

Barents Sea area, the model will augment the main Scenario Barents Sea modelling effort.

In reviewing the amount of multi-species modelling work and associated applications to management decisions that had been conducted world-wide over the past several years, the Working Group noted a much lower than expected activity in this area. This was considered surprising given the emphasis politicians and management authorities have placed on multi-species (ecosystem) approaches to the management of marine resources. While the principle of multi-species management seems to be widely accepted, the practical aspects of putting it into practice lag far behind the rhetoric. The Working Group emphasised that progress in this area will not be made unless significant additional resources are dedicated to it.

Research needs

The Working Group reiterated the research priorities identified by the NAMMCO Scientific Committee in 2001 (NAMMCO 2002). In particular the Working Group emphasised that additional information on harp seal diet and consumption in the Barents Sea is a priority to further the modelling work. The functional nature of prey selection by marine mammals under varying levels of prey abundance and from mixtures of available prey was also considered a priority for further research. To derive these functions diet data must be collected in conjunction with resource surveys at appropriate temporal and spatial scales. In addition the Working Group identified the following priorities:

Prey selection:
- theoretical and practical work on prey selection models
- development aggregated consumption functions
- migratory and spatial aspects of consumption models

Multi-species modelling:
- Further work on the Scenario Barents Sea model
- Use GADGET as a framework to generate template models for candidate areas in the North Atlantic

It was considered that discussion of the economic aspects of marine mammal-fisheries interactions would be premature until at least one of the two models above has been developed. Once models are available that can predict the variation in target species in response to management measures, linkages to simple economic models that assess the economic consequences of the responses can be made.

Discussion by the Scientific Committee

The Scientific Committee supported the conclusion of the Working Group that progress in the development and application of multi-species approaches to the management of marine resources was lagging far behind the stated need of management agencies for such approaches, and again emphasised that progress in this area will not be made unless significant additional resources are dedicated to it.

The Scientific Committee considered that it may have identified a way forward in addressing the requests from the Council, but stressed the importance of completing the necessary modelling work and collection of required input data before further progress on this matter can be made. For the modelling work, further progress cannot be made outside of the Barents Sea candidate area without additional resources, and the modelling effort for the Barents Sea could be enhanced with additional funding and manpower. Priorities for the collection of input data have been identified previously (NAMMCO 2000, 2001) but it cannot be expected that these data gaps can be filled within a short time frame, even if new resources are dedicated to the activity. If new resources are not available, the required input data cannot be collected and it will not be possible to provide the advice to the Council.

Witting, however, pointed out that even if required data should be collected, Minimum Realistic Models might not be able to realistically project the effects of an increased or decreased harvest of marine mammals. He argued that to firmly analyse the ecological effects of changes in the harvest of marine mammals a detailed understanding of the predator prey and competitive interactions of all relevant species is needed including a description of the density and prey dependent changes in the consumption functions of all species. While models that include all these interactions may, in principle, be able to predict the ecological impact of changed harvest levels, they represent unrealistic modelling approaches because it will be essentially impossible to estimate all the parameters. For most cases, he therefore found that it is unwise to base management on the predictions of multi species models, although he agreed that these models are needed for a more basic scientific level in order to obtain a better understanding of various ecosystems.

While there was some disagreement as to the suitability of minimum realistic models in general for providing management advice, it was agreed that this type of model was superior to the available alternatives. The Scientific Committee will assess any future modelling efforts critically with regard to the quality of input data, modelling assumptions and realism before deciding if any advice can be given.

The Scientific Committee agreed that the next meeting of the Working Group should focus on assessing modelling results from the Scenario Barents Sea model and possibly the GADGET-based template models for other areas, if they are developed. The Working Group should also consider the feasibility of connecting the multi-species models with simple economic models at that time. Walløe agreed to provide the Scientific Committee with a report on progress in the modelling efforts identified by the Working Group at next year's meeting. The Scientific Committee will assess progress made in modelling and in the collection of input data and decide at that time whether enough progress has been made to warrant another meeting of the Working Group.

Harp and hooded seals

An aerial survey for harp seals in the Greenland Sea was carried out during the period 14 March to 6 April 2002. The last survey was carried out in 1991. The results from the aerial surveys will be used to estimate the total 2002 harp seal pup production.

Subsequently, the status of the stock will be assessed by fitting population models to the pup production estimate. The ICES Working Group on Harp and Hooded Seals will meet in September 2003 to review these results and provide advice on stock management.

Narwhal

The Council has recommended that the Scientific Committee should concentrate its assessment efforts on the West Greenland narwhal in the near term, and that this assessment should be done jointly with the JCNB if possible. The Scientific Committee was informed about recent progress in satellite tagging and abundance surveys of narwhal in Greenland and Arctic Canada. A future assessment of narwhals in West Greenland may require two consecutive meetings to answer specific questions and to set scenarios for runs of population models. The Scientific Committee considered it advisable to hold the first assessment meeting in 2004, when surveys from several areas will have been completed and analysed. A subsequent meeting, probably in 2005, could deal with both narwhal and the new survey data for beluga which should be available at that time. Planning for future assessments will have to be done in conjunction with the Scientific Working Group of the JCNB, of which Witting is Chairman. He agreed to liaise between the two groups to find the best way to carry the assessment forward.

Beluga

Some new results from satellite tracking of belugas have become available since the Scientific Committee last performed an assessment in 2001, but the information does not provide a basis for altering the present advice. The next survey of belugas on the wintering ground in West Greenland is planned to be conducted in March 2004. Results from this survey will – assuming successful completion – be available for revising the present advice in the autumn of 2004 or in 2005.

The Scientific Committee noted with satisfaction the progress in implementing a quota system for beluga and narwhal in Greenland, but further noted that recent harvest figures for Greenland indicate that little or no reduction in catch has taken place. The Committee has advised on 2 occasions (2000 and 2001) that the stock is substantially depleted and that present harvests are several times the sustainable yield, and that harvests must be substantially reduced if the stock is to recover. The Committee stressed that the apparent delay in reducing the catch to about 100 animals per year will result in further population decline and will further delay the recovery of this stock.

Fin whales

In 2002 the Council clarified its previous request for advice on fin whales, asking that the Scientific Committee continue with its assessments of fin whale stocks in the areas of interest to NAMMCO countries with existing and new information on abundance and stock delineation as it becomes available.

An estimate of the abundance of fin whales from the NASS-2001 survey has been completed. The Committee noted that abundance estimates from the Norwegian

survey area of the NASS-1995 survey have not been published, and estimates from subsequent surveys in the Norwegian area have not yet been produced. The Committee recommended that these estimates be completed on a timely basis.

Efforts to tag fin whales with satellite-linked tags have continued in the Faroes, Greenland and Iceland. In the Faroes, 12 tag deployments have been made in the past 2 years, of which 2 have transmitted data. One of these animals moved into the waters west of Bay of Biscay. Collection of tissue samples for genetic analysis has continued in the Faroes, Greenland, and Norway. In the Faroes and Norway, samples are collected through a biopsy program, while in Greenland samples are taken from the annual catch. Iceland has a large collection of tissue samples from historical catches, however virtually all of these are from western Iceland. The Committee noted that satellite tagging had indicated an apparent connection between fin whales in Faroes and in the waters near Spain and urged the addition of tissue samples from fin whales in these waters to ongoing studies on stock structure of North Atlantic fin whales.

The Scientific Committee noted that the success rate of deploying satellite tags on fin whales and other large whales was low and variable between research teams. There are several research groups working on large whale tagging in NAMMCO member countries, the USA, Japan and other countries, and the field is quite competitive. The Committee decided to establish an intersessional correspondence group to:

- identify progress in satellite tagging made in NAMMCO member countries and elsewhere;
- explore the technical aspects of satellite tagging, including deployment systems;
- briefly consider what tagging experiments have been done and the rates of success;
- recommend ways to further the development and success of this technique in NAMMCO member countries.

The Committee will report their findings at next years meeting of the Scientific Committee.

The Scientific Committee considered that the new abundance data for the Faroese and Icelandic areas could allow the assessments for these areas to be updated in the coming year. An assessment of fin whales in the Norwegian area could be attempted if abundance estimates for the area are completed. Consideration should be given to contracting an update of the genetic analysis including new samples from the Faroes.

Minke whales

In 2002 the Council recommended that the Scientific Committee should complete an assessment of Central Atlantic minke whales once new abundance estimates from NASS-2001 become available.

Estimation of abundance from the 2001 aerial survey and a reanalysis of the 1987 aerial survey data are presently being conducted under contract. Analysis of the ship survey data from 2001 is in progress. Analysis of the 1996-2001 series of Norwegian sightings surveys, which includes part of the Central Atlantic stock, has been

completed and reported to the IWC. An aerial digital photographic survey of minke whales and other species is being conducted in 2002 in West Greenlandic waters, and will be repeated in 2003. Satellite tags have been deployed on 2 minke whales this year in Icelandic waters. Genetic analyses of the large number of samples from the Norwegian catch are ongoing. However more samples from surrounding areas, including the Faroes and Iceland, are required to refine the analysis. The Scientific Committee recommended that tissue samples be collected from these areas by biopsy or other means.

The Scientific Committee considered that a new assessment of the Central Atlantic stock could be conducted after the Working Group on Abundance Estimates has considered the new estimates from the Icelandic aerial survey and the Icelandic and Faroese ship surveys from NASS-2001.

White-beaked, white-sided dolphins and bottlenose dolphins

An abundance estimate for primarily white-beaked dolphins from the NASS-2001 Icelandic aerial survey has been produced, and estimates from previous aerial surveys are in progress. Estimates from the ship surveys have not been developed. Sampling programs from Icelandic by-catch of whitebeaked and the Faroese drive hunt whitesided and bottlenose dolphins have been conducted, and reports on life history and general ecology should be produced in the coming year. Norway will be initiating a sampling program involving the collection of approximately 60 whitebeaked dolphins for life history, genetic and feeding analyses. In addition biopsy samples are collected during sightings surveys.

At this point the Scientific Committee considered that there was still insufficient information on abundance, stock relationships, life history and feeding ecology to go forward with the requested assessments for these species. This may become feasible once further abundance estimates from the Icelandic and Faroese areas are produced, and the ecological studies in the Faroes, Iceland and Norway are completed. The Scientific Committee recommended that these studies be completed in a timely manner

Grey seals

In 2002 the Council requested that the Scientific Committee provide a new assessment of grey seal stocks throughout the North Atlantic. Dr. Kjell Nilssen has accepted the position of chairman of the new Grey Seal Working Group. The general terms of reference of this Working Group will be:

- to assess the status of greys seals around Iceland, the UK, the Faroes, Norway, the Russian Federation, the Baltic, Canada and other areas;
- survey methods;
- stock delineation (genetics, temporal and geographical distribution);
- recommendations.

It was decided that the meeting should be held in early April in Iceland. As surveys for this species are being conducted in Iceland and Norway in 2002, and due to other international meetings with overlapping agendas it was not considered feasible to schedule a meeting for this WG earlier than this.

Humpback whales

In 2002 the Council recommended that the Scientific Committee complete abundance estimates for this species as a high priority, and should also consider the results of the "Years of the North Atlantic Humpback" (YoNAH) project as it pertains to member countries in providing advice for this species.

The Scientific Committee noted that abundance estimates are being completed for this species as a high priority. New abundance estimates from the NASS-2001 aerial and ship surveys are presently under development and there is evidence from the Icelandic aerial surveys that the stock is increasing at a rapid rate in that area. There has also been an increase in both incidental and survey sightings around the Faroes. The aerial digital photographic survey being conducted in West Greenland should provide an estimate of abundance in that area. Efforts to obtain photographs and biopsy samples from eastern Icelandic waters were continuing, as had been recommended last year. In Greenland, 4 satellite tags have been successfully deployed on humpback whales this year.

Information from the YoNAH project, pertaining to stock delineation, migration, biological parameters, and abundance both North Atlantic-wide and in feeding areas has been published. The Scientific Committee has noted previously (2001) that estimates from the NASS-95 survey appear to conflict with the results of the YoNAH project, and comparison with the estimates from NASS-2001 should be of great interest.

North Atlantic sightings surveys - NASS-2001

Minke whales

Analysis of data from the Faroese and Icelandic ship surveys is presently in progress. A preliminary estimate from the aerial survey around Iceland has been completed, and the final analysis is being conducted by a contractor. An analysis of trends in distribution and abundance of minke whales from aerial surveys conducted in the coastal waters of Iceland in 1986, 1987, 1995 and 2001 showed that the distribution of minke whales was very stable from year to year, with highest densities in the SW, N and SE waters of Iceland. Relative abundance showed a significant increase in the area to the N of Iceland, and moderate but non-significant increases in the high-density area in SW Iceland (Faxaflói), NW Iceland and in the survey area as a whole, over the period. The Scientific Committee concluded that the abundance of minke whales around Iceland has been stable or shown a moderate increase over the period, and that the apparent increase in relative abundance in the area to the N of Iceland is consistent with population growth after cessation of catching.

Fin whales

An abundance estimate of 25,352 (95% CI 19,579 to 32,831) from the ship survey around Iceland and the Faroe Islands was accepted by the Scientific Committee. This is higher and more precise than estimates from equivalent areas from past NASS surveys. While some of this increase may be related to increases in survey efficiency, this factor alone likely cannot explain the observed increase since 1987. Stock increase, immigration from other areas, and/or variation in distribution between years

may also be involved. The four NASS ship surveys carried out since 1987 provide an excellent time series of abundance for this species. It was therefore recommended that a more complete analysis of changes in abundance over all the NASS surveys be conducted. This may require some re-analysis of past survey data as the coverage has changed between surveys.

Humpback whales

A preliminary line transect estimate for humpback whales from the 2001 Icelandic aerial survey has been completed, resulting in and estimate of 3,057 (95% CI 1,727 - 5,410) for the area. However this estimate has a negative bias because of animals missed by the observers and, probably more importantly, animals missed because they were diving when the plane passed.

Sightings from the NASS-2001 ship survey were highly clustered around NE and W Iceland within the aerial survey block, but substantial numbers were also seen in areas farther offshore. More sightings were made in the Faroese block than in previous surveys. An analysis of these data and from the 1995 survey is presently being conducted by a contractor.

An analysis of the trend in sighting rate over the course of the 4 Icelandic aerial surveys carried out since 1986 showed an increase of 11.4% (SE 2.1%) per year over the period in the survey area. This rate of increase is in accordance with that of 11.6% over the period 1970 - 1988 in recorded sightings of humpback whales by whalers operating west of Iceland. There has been almost no catch of humpback whales around Iceland since the first stage of Icelandic whaling came to an end in 1915. Therefore, stock recovery is one plausible explanation for the trend, however the observed rate is on the edge of biological plausibility. Immigration from other areas may also be playing a role.

Lagenorhynchus dolphins

A preliminary abundance estimate for the Icelandic aerial survey has been completed, resulting in an estimate of 20,444 (95% CI 12,714 - 32,874). This estimate is biased downwards both by animals missed by observers and animals that were underwater when the plane passed over.

Analysis of the ship survey data from 2001 and earlier surveys is considered problematic because of uncertain species identification, uncertain group size estimation, and possible responsive movement of these species.

Sperm whales

A calculation of sperm whale abundance from the 2001 Icelandic and Faroese shipboard surveys, using a combination of cue-counting and line transect methodologies, resulted in an estimate of 11,185 (CV 0.34) for the area. However this estimate is heavily dependent on estimates of the proportion of the time the whales spend at the surface, and the frequency of deep dives, for which there is no data for the survey area. Once these data are collected, probably through radio-tagging studies, the estimate can be revised.

Other species

The Scientific Committee considered that, in addition to the species already mentioned, abundance estimates from the ship survey were feasible for pilot whales and bottlenose whales. These analyses should be completed in the coming year. For other species, such as killer whales and blue whales, the data are not suitable for the estimation of abundance, but general descriptions of distribution will be produced.

Evaluation of survey methodologies

The Working Group provided a detailed evaluation of the methodologies used in the ship and aerial surveys, and a list of recommendations for improvements. The Scientific Committee considered that the Report and the contributory working papers should serve as an excellent guide for the planning and conduct of future NASS surveys.

Future work

The Scientific Committee agreed that completion of the following analyses should be of high priority:

i. Aerial survey estimate of minke whales around Iceland from 2001 and 1987, accounting for bias due to measurement error and whales missed by observers. This work is presently being pursued under contract.
ii. Spatial analysis of humpback whale distribution and abundance, from 2001 and 1995 ship and aerial surveys. This work is presently being pursued under contract.
iii. Abundance estimate of minke whales from Faroese and Icelandic ship surveys, 2001. This is in progress;
iv. Abundance estimates for dolphins from the 2001 and earlier surveys;
v. Abundance estimates for pilot whales and northern bottlenose whales from the 2001 survey.

It was anticipated that all or most of this work could be completed in time for a meeting of the Working Group early in 2003.

Status for analyses and publications from previous NASS surveys

Although the idea of publishing a volume on the North Atlantic Sightings Surveys (NASS) was dropped in 2000 by the Scientific Committee, it was revived in 2001 following the NASS-2001 survey. The Scientific Committee agreed that a special volume on the NASS surveys in general would be of great interest to many researchers. Four NASS surveys have been conducted, over a long enough time frame that temporal trends in distribution and abundance may be detectable. The volume therefore should not merely report abundance estimates from the later surveys, but should synthesise results from all the NASS surveys to elucidate temporal and spatial patterns. It was considered that the volume could best be organised by species, with contributors using information from all the NASS surveys regardless of national affiliation.

It was agree that Dr Nils Øien and Daniel Pike would edit the new volume. Given the amount of work that remains to be done, this volume will not be completed before sometime in 2004.

Provision of advice on sustainable catch to council

The Scientific Committee considered ways in which it could improve and enhance the provision of its advice on sustainable catches to the Council. A review of requests for advice from the Council shows that they have varied quite widely, ranging from general requests for stock assessments, to requests mentioning specific potential catch levels. It was apparent that more specific and detailed requests for advice from the Council resulted in more useful advice from the Scientific Committee. The Scientific Committee agreed that the explicit statement of management goals was one of the most important considerations in providing high quality scientific advice on sustainable catch. Requests for advice on catch levels should contain a minimum of information about management goals and timelines so that they can be responded to effectively. It was agreed that a Correspondence Group should be established to provide guidance to the Council in the most effective formulation of requests for advice, and report back to the Committee in advance of the next meeting of the Council.

Relatively few organisations involved in fishery management actually use a well-defined management procedure, the prime example being the Revised Management Procedure (RMP) developed by the IWC. While the use of an explicit and documented management procedure or procedures would have some advantages for the Scientific Committee and NAMMCO as a whole, the Committee considered that the wide range of species and harvesting activities subject to NAMMCO advice, and the lack of clear and explicit management goals, would make development of a single or even multiple management procedures difficult or impossible for NAMMCO. The Committee considered that one of the main problems with the use of explicit management procedures such as the RMP was the lack of flexibility in adapting to different management goals and different types of fisheries. While part of the intention in developing such procedures was to reduce the workload on the committee providing advice, experience with the RMP had shown that this was not necessarily the end result. The Committee was also concerned that once an explicit management procedure is adopted at the political level, it can be difficult to change some of the parameters and assumptions of the procedure even if they are demonstrated to be false.

The Scientific Committee favoured an approach where advice on catch levels is presented in a form that shows the probability of achieving desired stock trajectory under different catch options, with a full evaluation of the uncertainty of the predictions, if sufficient data are available to support such an assessment. The advice provided for West Greenland beluga is one example of this approach. In conducting assessments, it is also advantageous to use more than one assessment model if available, as this increases confidence in the results.

NAMMCO Science Fund

At the 9th meeting of the NAMMCO Council in 1999, the Chairman of the Scientific Committee, Dr Mads Peter Heide-Jørgensen, proposed that the Scientific Committee be given the option of conducting its own research with funding provided by the Council. Subsequently the Scientific Committee developed a full proposal for such a

Science Fund, with examples of projects that would address issues put to it by Council, and could be supported within the proposed funding level of the Science Fund. The proposal for the Science Fund, along with these examples of projects that could be conducted under the program, was presented to the Council at their 11th meeting in February 2002. The Council decided not to support the establishment of a NAMMCO Science Fund. The Council did however acknowledge that a better way must be found to convey the priorities of NAMMCO to National Research Institutions.

The Scientific Committee expressed its profound disappointment that a Science Fund could not be established. As the intention of the Fund was to fund research that would facilitate and accelerate the response of the Scientific Committee to requests put to it by the Council, the Committee noted that its recommendations for research must be acted upon by national research institutes if the requests of the Council are to be fulfilled in a timely manner.

Publications

Three volumes of NAMMCO Scientific Publications have now been published: Vol. 1 *Ringed seals in the North Atlantic*, Vol 2 *Minke whales, harp and hooded seals: Major predators in the North Atlantic ecosystem*, and Vol. 3 *Sealworms in the North Atlantic: Ecology and population dynamics*. The latter was published late in 2001 and has been distributed to libraries, research institutions and to journals for review.

The following volumes are presently in progress: Vol. 4 *Belugas in the North Atlantic and the Russian Arctic***.** ed. Heide-Jørgensen, M.P. and Wiig, Ø. which should be published in October; Vol. 5 *Harbour porpoises in the North Atlantic* (no title chosen yet). ed. Haug, T., Desportes, G., Víkingsson, G. and Witting, L., which should be out early in 2003. In addition the Scientific Committee has decided to proceed with a volume on the North Atlantic Sightings Surveys (see above)

Future work plans

It was decided that Greenland should host the next meeting of the Scientific Committee in November 2003, at a location yet to be determined.

At least 4 working groups are expected to be active in 2003: Grey Seals, Abundance Estimates, North Atlantic Fin Whales and North Atlantic Minke Whales. In addition two new groups will meet by correspondence: Satellite Tagging and Advice Requests. Given the number of meetings and the fact that some contract work will be necessary to support these activities, costs might exceed the usual budget allocation of the Scientific Committee.

Election of officers

Gísli A. Víkingsson was elected as chairman for an additional year, and Lars Walløe was elected as vice chairman.

REPORT OF THE TENTH MEETING OF THE NAMMCO SCIENTIFIC COMMITTEE

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

Chair Gísli A. Víkingsson welcomed the members of the Scientific Committee to their 10th meeting (Appendix 1), held at the whaling station at Hvalfjörður. He noted that Lars Walløe had replaced Dr Nils Øien on the Committee. On behalf of the Scientific Committee Víkingsson expressed his thanks to Dr Øien for his great contribution to the scientific work of NAMMCO, and welcomed Lars Walløe to the Committee. Members Mads Peter Heide-Jørgensen and Christian Lydersen did not attend the meeting.

2. ADOPTION OF AGENDA

The Draft Agenda was accepted with minor changes (Appendix 2).

3. APPOINTMENT OF RAPPORTEUR

Daniel Pike, Scientific Secretary of NAMMCO, was appointed as Rapporteur.

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

4.1 National Progress Reports

National Progress Reports for 2001 from the Faroes, Greenland, Iceland, and Norway were presented to the Committee.

4.2 Working Group Reports and other documents

Working Group Reports and other documents available to the meeting are listed in Appendix 3.

5. CO-OPERATION WITH OTHER ORGANISATIONS

5.1. IWC

The 54th meeting of the Scientific Committee of the International Whaling Commission was held in Shimonoseki, Japan, from 25 April to 11 May. Daniel Pike attended as observer for the NAMMCO Scientific Committee.

An Implementation Review for North Atlantic minke whales was scheduled for this year. However the Norwegian authorities were not able to provide the required data and estimates of abundance for Northeast Atlantic minke whales 3 months in advance of the Scientific Committee meeting, as stipulated under the Revised Management Procedure. Therefore the Implementation Review will be continued in 2003. Information on minke whale abundance from the 1996 - 2001 survey period was presented to the Scientific Committee. The abundance estimate for this period was substantially lower than that for 1995. Information on minke whale genetics, dive times and ageing was also presented to the Scientific Committee.

The comprehensive assessment of North Atlantic humpback whales was continued from last year. This year new information on abundance around Iceland from the NASS-95 survey, and trend in abundance from the NASS aerial surveys (1986-2001) and observations from whalers (1956-1985), was used in the assessment. The assessment model was also further developed. The new assessment model was again unable to reconcile all the available data, and predicts that the population should have reached carrying capacity by now. However it still appears to be growing in some areas.

The Committee considered that an increase in the take of humpback whales by St Vincent and the Grenadines from 2 to 4 whales was unlikely to have an impact on the population, assuming that the whales found in the Eastern Caribbean are part of the West Indies breeding stock.

Survey reports from the NASS-2001 shipboard and aerial surveys around Iceland were presented to the Committee. In addition, abundance estimates for fin and sperm whales were presented. The Committee did not have time to fully consider these reports. However, the Committee noted that the sharing of platforms with an international redfish survey had been successful during NASS-2001, and recommended that nations participating in the redfish survey incorporate a cetacean survey.

Work on the Aboriginal Subsistence Management Procedure continued, and the Committee selected a strike limit algorithm (SLA) for the Bering-Chukchi-Beaufort bowhead whale stock. The Committee is now moving ahead with trials of SLA's developed for Eastern Pacific grey whales.

The Committee discussed plans for a new aerial survey off Greenland for minke and fin whales to be carried out in 2002. The survey will use digital photography in a strip transect design.

The third circumpolar series of IWC-SOWER sighting surveys (CPIII) in the Southern Ocean will be completed this year. Results to date indicate that abundance from CPIII is about 46% of that from CPII, a significant decrease. Many possible reasons for this apparent decrease were discussed, including real population change, lower g(0) in later surveys, and an increase in the proportion of animals in areas not surveyed, especially pack ice areas. No consensus was reached, and the evaluation will continue next year.

The Committee decided to begin an in-depth assessment of sperm whales, and established an intersessional working group to begin planning.

The Scientific Committee conducted a very extensive review of the proposed JARPN II research program by Japan, which involve lethal sampling of up to 150 minke whales, 50 Brydes whales, 50 sei whales and 10 sperm whales annually, according to guidelines previously set for such reviews. In addition the Committee conducted a scheduled review of the Indian Ocean Sanctuary.

5.2 ICES

Haug reported on recent developments in ICES. One ICES committee that deals with marine mammals as an important issue is the Living Resource Committee (LRC). Suggested future theme sessions under the LRC with relevance to marine mammals include titles such as: ”Environmental Influences on Trophic Interactions”, ”Biological Effects of Contaminants in Marine Pelagic Ecosystems” and ”Monitoring Techniques and Estimating Abundance of Seals”.

The ICES Working Group on Marine Mammal Population Dynamics and Habitats (WGMMPH), met in May 2002 by correspondence to develop further the basis for advice, following a request from the European Commission, on cetacean bycatch and bycatch mitigation measures in European Union fisheries. Information on by-catches of cetaceans in various gear types was reviewed and possible limitations in use of gear and time/area closures discussed. Questions concerning the use of pingers, gear modifications, and other mitigation measures were addressed. WGMMPH will meet again in March 2003 to address issues such as by-catches of marine mammals in fisheries, the role of seal epizootic events in population regulation, census techniques used in seal abundance estimation, and the effects of expanding seal populations.

The Scientific Committee noted the continuing overlap of interests between NAMMCO and ICES, particularly with regard to harp, hooded and grey seals, and bycatch issues with small cetaceans, and urged scientists from member countries to participate in the ICES working groups to the extent feasible.

5.3 Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga

Neither the Joint Commission nor the Scientific Working Group has met since the last meeting of the Scientific Committee. Witting has been appointed chairman of the Scientific Working Group, and indicated that the next meeting would be held jointly with the NAMMCO Scientific Working Group on the Population Status of North Atlantic Narwhal and Beluga if feasible.

6. INCORPORATION OF THE USERS KNOWLEDGE IN THE DELIBERATIONS OF THE SCIENTIFIC COMMITTEE.

Grete Hovelsrud-Broda (General Secretary to NAMMCO) reported on the upcoming NAMMCO Conference on User Knowledge and Scientific Knowledge in Management Decision Making to be held in Reykjavik, Iceland 4 – 7 January 2003. The overall goal of the Conference is to find ways to incorporate the knowledge of users (whalers, sealers and fishermen) into the management decision-making process in parallel with science. The idea for the Conference emerged from the apparent disagreement between the users on the one hand, and the scientists on the other with respect to, for example, the actual numbers of animals (and fish) found in an area, their migratory routes, feeding habits and biology. Management decisions are predominantly based upon the western-based knowledge system of science, although co-management programs exist. While marine resource management has great impact on the resource users, their knowledge is not included in the same manner as science

in management decisions. The two knowledge systems differ in a number of ways, and the conference will compare and contrast these in terms of how the knowledge is gathered, stored, used and transmitted. Thus the Conference will compare the foundation of the two systems of knowledge in relation to resource management, of in particular, marine mammals. The speaker list includes scientists, users and managers. The topics will focus on experience from existing projects, the foundations of user and scientific knowledge, a comparison of the two, the management decision making process in terms of the information sought in management decisions, and the process of drafting regulations, and the role and application of user and scientific knowledge. The Conference will also include two discussion sessions between panellists and the open forum of participants. A drafting group will be established to assess the similarities and differences between the systems of knowledge, and if the meeting so decides will draft a set of recommendations on how to move forward in incorporating user knowledge in the management decision making process. The Secretary urged the Scientific Committee members to attend the Conference.

The Scientific Committee supported this initiative and urged members to attend if possible. It was suggested that the inclusion of input from fisheries science and management, which have a long history in this area, would be useful.

7. UPDATE ON STATUS OF MARINE MAMMALS IN THE NORTH ATLANTIC

At its 8th meeting in 1998 the Council asked the Scientific Committee to develop a strategy for how to incorporate the knowledge of users in the advice provided by the Scientific Committee. A strategy to utilise Stock Status Reports as a means to incorporate user knowledge was approved by the Scientific Committee at their 7th meeting. Under this system stock status reports would be developed by the Scientific Committee on stocks for which the Committee had provided advice. These documents would be used as the basis of discussion with user groups, and their input would be incorporated. The resulting documents would then reflect the best available scientific and user knowledge about the stock.

At its 9th meeting in 1999 the Council endorsed this proposal. Two stock status reports, on minke and pilot whales, have since been completed, but the process of integrating user knowledge has been delayed pending the outcome of a NAMMCO conference on this topic (see Item 6). Also, these reports will have to be updated to incorporate new results from NASS-2001, and a pending assessment by NAMMCO for minke whales.

Pike reported that he had completed a draft of the Stock Status Report for ringed seals, and provided it for the review of the Scientific Committee. Work on other reports has been delayed due to competing priorities, but the next priorities for completion will be walrus, beluga and fin whales. It is anticipated that the first 3 stock status reports (minke whales, pilot whales, ringed seals) will be placed on the NAMMCO web site in fall 2002.

The Scientific Committee reiterated the importance of completing these documents, and suggested that members having a special interest in certain species could complete the initial draft for those species. For other species, the idea of contracting out production of the reports should be considered. Pike agreed to provide interested members with the format of the stock status reports, and to look into the idea of contracting the production of reports for species for which there is no special expertise on the Committee.

8. ROLE OF MARINE MAMMALS IN THE MARINE ECOSYSTEM

8.1 Working Group on Marine Mammal - Fisheries Interactions

Background

At its 8th meeting, the NAMMCO Council tasked the Scientific Committee with providing advice on the economic aspects of marine mammal-fisheries interactions. A Working Group on the Economic Aspects of Marine Mammal - Fisheries Interactions met in February 2000 to consider parts of the request. One of the conclusions of the Working Group was that significant uncertainties remain in the calculation of consumption by marine mammals, and this uncertainty was the most important factor hindering the development of models linking consumption with fishery economics (NAMMCO 2001). Considering this conclusion, the Scientific Committee decided to convene a workshop to further investigate the methodological and analytical problems in estimating consumption by marine mammals. This workshop was held in Tromsø in September 2001 and resulted in, among other things, a list of research priorities to refine existing estimates of consumption by North Atlantic marine mammals (NAMMCO 2002).

The Scientific Committee viewed the next logical step in this process to be a review of how presently available ecosystem models can be adapted in order to increase our understanding of and quantifying marine mammal - fisheries interactions. Several different candidate models had been identified: the Icelandic BORMICON/GADGET, the Norwegian MULTSPEC and Scenario Barents Sea, and ECOPATH/ECOSIM. The Workshop was held in Reykjavik in September 2002. It was tasked with choosing a preferred modelling approach for analysing the ecological role of minke whales, harp and hooded seals, and other marine mammal species in the North Atlantic, identifying required input data, and recommending a process for further development. The Working Group was not expected to review results or make quantitative predictions at the meeting, but rather to focus on methodological problems.

The Scientific Committee of the International Whaling Commission had held a workshop on a similar theme in La Jolla, California in June 2002. Some of the results from the IWC meeting were summarised for the Working Group. A general conclusion from the IWC meeting was that interactions between marine mammals and fish species are a topic worthy of quantitative scientific investigation. The IWC workshop investigated several candidate-modelling tools, including MULTSPEC and ECOPATH/ECOSIM.

Available multi-species models

The Working Group considered descriptions of the range of available multi-species

modelling tools. This includes two general classes of models typified by the Minimum Realistic Models (MRM) on the one hand and the ECOSIM/ECOPATH approach on the other. The MRM class includes MULTISPEC, BORMICON/GADGET and Scenario Barents Sea. These models share the characteristics of being system specific, modelling only a small component of the ecosystem for a specific purpose, and treating lower trophic levels and primary production as constant or varying stochastically. In contrast, ECOPATH/ECOSIM is an all-inclusive approach that incorporates lower trophic levels and primary production.

MULTSPEC, which was established at the Institute of Marine Research in Bergen, is a general-purpose multi-species simulator for the Barents Sea. It was initially designed to be a tool for calculating the spawning biomass of capelin, but later interactions between fish and marine mammals were included. At present the species capelin, cod, herring, polar cod, minke whales and harp seals are modelled.

When marine mammals were added to the fish species some rather counter-intuitive results were obtained. There proved to be a larger gain in the cod fishery by removing the seal population from the model than by removing the whale population, even if the whales eat more cod. Also, decreasing the suitability of herring as food for cod had a larger effect on the yield from the fisheries than removing the marine mammals altogether. The reason for this lies with the cod-herring-capelin dynamics. In order to get the marine mammals – fish interactions right the fish-fish interactions must be right. At present MULTSPEC is resting and there has not been active work on this model for several years due to lack of resources.

Scenario Barents Sea is a series of projects at the Norwegian Computing Center in Oslo with extensive help and advice from Institute of Marine Research in Bergen and Tromsø. The two first projects were carried out from 1993 to 1999, while a new project funded by the ministry of Fisheries will be carried out in the period 2002-2004.

The previous projects compared management strategies for cod and herring (Hagen *et al* 1998); studied among other things the direct and indirect effects of minke whale abundance on cod and herring fisheries (Schweder *et al.* 2000a), and also compared management strategies with respect to long term resource rent, harvest capacity, catch, and abundance of cod (Schweder *et al.* MS 2000b).

When studying the interaction between management of marine mammals and fish, the model in the previous projects includes 4 species: cod, capelin, herring and minke whales. The catch of cod was estimated to increase by some 6 tons with the removal of every minke whale from the population. Schweder *et al* (2000a) found further that minke whale abundance affects the cod fishery in a linear fashion over a wide range of minke whale abundance. The results concerning the effects on the cod and herring fisheries must be taken as tentative since the ecosystem model used could be improved, and so could the strategies for managing the fisheries.

In the new project harp seals will be included in the model. The aim is to study how various management strategies for marine mammals will affect the Norwegian fish-

fisheries, on the basis of our current knowledge and data concerning the population dynamics of, and interaction between, harp seals, minke whales, cod, herring and capelin. Another aim is to identify gaps in our knowledge, and pressing data needs. A long-term goal is to transport the various components of the model to the system GADGET, and to build the model further in this system.

BORMICON (A BOReal MIgration and CONsumption model) was a multi-species, spatially disaggregated model initially developed for Icelandic waters. It took into account growth as a function of consumption and allows the user to specify their preferred likelihood functions. The current program, GADGET (Globally Applicable Area-Disaggregated Generic Ecosystem Evaluation Tool), is a fully parametric forward simulation model (and can therefore in principle be run without any data). A simulation results in population trends by species, size class, age group, area and time step. These trends can subsequently be compared to data using appropriate likelihood functions, eventually maximising the likelihood functions to obtain parameter estimates. Consumption within GADGET is modelled using suitability functions and mortality can be either due to predation, other natural causes or fishing.

The Working Group was impressed with the scope and ambition of this project in attempting to establish a framework for ecosystem models of various levels of complexity. When put to use, the GADGET system will provide a strong and unified platform for data handling, scenario modelling and simulation, and model fitting. Such a unified platform is certainly welcome, and so is the information technology that is brought together in GADGET. However, even with as good information technology as GADGET, it must be remembered that GADGET is a platform upon which models can be built. Scenario- and assessment models are necessarily case specific, and all the specifics needs to be worked out in each particular case. It was noted that marine mammals have not been included in any of the GADGET case studies to date. The project has limited funding, and will not accomplish much more in the time left beyond putting together the currently available data and knowledge in the existing framework.

ECOPATH is an equilibrium approach to multi-species modelling. Mass balance equations are used, essentially relating production by some species to predation by others under the assumption that the system is in a steady state. Unlike the models discussed above, ECOPATH also considers the lower trophic components of the ecosystem, e.g. plankton. ECOSIM builds upon this approach, but drops the equilibrium assumption so that the system is modelled by a set of coupled differential equations. Potentially ECOSIM could provide a basis to provide advice on marine mammal-fisheries interactions. An advantage of the package is the structured framework it provides to setting out species-specific inputs required for multi-species modelling. Potential disadvantages discussed included the in-built functional forms for species interactions, and simplified treatment of age-structure, that may not be appropriate for the particular cases to be considered. Another problem is the large number of parameter values that need to be specified; some of these may have an appreciable impact on outputs, and the default suggestions provided by the package may not be the most appropriate in all circumstances.

Prey selection processes

To elucidate the prey selection function of minke whales, Norwegian Institute of Fisheries and Aquaculture performed studies of minke whale foraging dynamics in selected areas in the southern Barents Sea in 1998 and 1999. Stomach contents were sampled onboard commercial whaling vessels whereas the resource availability was assessed using standard acoustic surveys by research vessels.

Studies of the type presented provide estimates of prey selectivity at the micro-scale. However, multi-species models require estimates of such consumption functions at the macro-scale (the spatio-temporal scale of the strata adopted for the population dynamics modelling). Conversion of the results from microscale experiments on selectivity to yield macroscale estimates is not straightforward, as the results will depend on the spatio-temporal distributions of predators and their different prey species, and the former may alter in response to changes in the latter.

There is a rich economic literature on human choice- and consumer behaviour, and there is a wealth of experience in estimating models on both the individual level and on the aggregated level. The economic paradigm of rationality is that humans make their choices on the basis of utility maximisation within the options available in the situation, and under budget constraints. A weak form of this paradigm might also be used when modelling animal behaviour on the micro level.

Recommended modelling approach for NAMMCO

Considering the data available or likely to become available in the foreseeable future, the Working Group favoured the approach of using a limited model that encompassed only the major species of interest, as opposed to an all-encompassing model where all or most species are included, as a basis for potential management advice in the short to medium term. This approach can be described as a Minimum Realistic-type model, as exemplified by Scenario Barents Sea, MULTSPEC and BORMICON. Other components of the ecosystem that are not explicitly modelled, such as primary production or zooplankton, could be left as constant, allowed to vary randomly or linked to environmental covariates.

Some members voiced the concern that the development of ecosystem models without sufficient data in some components would produce results that might be used by inappropriately by managers, who might not understand the level of uncertainty in the results even if it is specified. It was suggested that it would be better to wait until the required data is gathered before proceeding to ecosystem modelling. Other members noted that even models in which some components are parameterised with “plausible ranges” can be useful in determining the sensitivity of the model to variation in parameters, and thus in determining the most important gaps in knowledge. It was agreed that the two activities should proceed simultaneously: that is, the data gaps identified should be filled by dedicated studies, while modelling can proceed in candidate areas, even with partial data, as long as the uncertainty of the results is emphasised and integrated in the results. In this way, modelling approaches can be refined and the reliability of the results will improve as more data is gathered.

There was agreement that the continued development of the Scenario Barents Sea model should be a priority, with emphasis on incorporating the predation of harp seals in the model. In addition the Working Group recommended the development of a second, more general North Atlantic "template" model based on the GADGET platform. This spatially homogeneous model would include species important in candidate applications to West and East Greenland, Iceland and the Barents and North Seas. However the abundance of these species would be varied between the areas according to available information. The quality of the available input data varies greatly between areas, and in cases where little information is available, plausible ranges would be used. It will be crucial to capture the full range of uncertainty in these ranges. In areas where data is lacking, such as West Greenland, the main use of such a model will be to identify the sensitivities to variation in input parameters, and thus to assist in the setting of priorities for research. In Icelandic waters, where better data is available for fish but data on marine mammal diets and prey selection are scarce, such a model will serve the same purpose but also generate preliminary scenario results for management. For the relatively data-rich Barents Sea area, the model will augment the main Scenario Barents Sea modelling effort.

In reviewing the amount of multi-species modelling work and associated applications to management decisions that had been conducted world-wide over the past several years, the Working Group noted a much lower than expected activity in this area. This was considered surprising given the emphasis politicians and management authorities have placed on multi-species (ecosystem) approaches to the management of marine resources. While the principle of multi-species management seems to be widely accepted, the practical aspects of putting it into practice lag far behind the rhetoric. The Working Group emphasised that progress in this area will not be made unless significant additional resources are dedicated to it.

Research needs

The Working Group reiterated the research priorities identified by the NAMMCO Scientific Committee in 2001 (NAMMCO 2002). In particular the Working Group emphasised that additional information on harp seal diet and consumption in the Barents Sea is a priority to further the modelling work. The functional nature of prey selection by marine mammals under varying levels of prey abundance and from mixtures of available prey was also considered a priority for further research. To derive these functions diet data must be collected in conjunction with resource surveys at appropriate temporal and spatial scales. In addition the Working Group identified the following priorities:

Prey selection:
- theoretical and practical work on prey selection models
- development aggregated consumption functions
- migratory and spatial aspects of consumption models

Multi-species modelling:
- Further work on the Scenario Barents Sea model

- Use GADGET as a framework to generate template models for candidate areas in the North Atlantic

It was considered that discussion of the economic aspects of marine mammal-fisheries interactions would be premature until at least one of the two models above has been developed. Once models are available that can predict the variation in target species in response to management measures, linkages to simple economic models that assess the economic consequences of the responses can be made.

General discussion

The Scientific Committee supported the conclusion of the Working Group that progress in the development and application of multi-species approaches to the management of marine resources was lagging far behind the stated need of management agencies for such approaches, and again emphasised that progress in this area will not be made unless significant additional resources are dedicated to it.

The Scientific Committee considered that it may have identified a way forward in addressing the requests from the Council, but stressed the importance of completing the necessary modelling work and collection of required input data before further progress on this matter can be made. For the modelling work, further progress cannot be made outside of the Barents Sea candidate area without additional resources, and the modelling effort for the Barents Sea could be enhanced with additional funding and manpower. Priorities for the collection of input data have been identified previously (NAMMCO 2001, 2002) but it cannot be expected that these data gaps can be filled within a short time frame, even if new resources are dedicated to the activity. If new resources are not available, the required input data cannot be collected and it will not be possible to provide the advice to the Council.

Witting, however, pointed out that even if required data should be collected, Minimum Realistic Models might not be able to realistically project the effects of an increased or decreased harvest of marine mammals. He argued that to firmly analyse the ecological effects of changes in the harvest of marine mammals a detailed understanding of the predator prey and competitive interactions of all relevant species is needed including a description of the density and prey dependent changes in the consumption functions of all species. While models that include all these interactions may, in principle, be able to predict the ecological impact of changed harvest levels, they represent unrealistic modelling approaches because it will be essentially impossible to estimate all the parameters. For most cases, he therefore found that it is unwise to base management on the predictions of multi-species models, although he agreed that these models are needed for a more basic scientific level in order to obtain a better understanding of various ecosystems.

While there was some disagreement as to the suitability of minimum realistic models in general for providing management advice, it was agreed that this type of model was superior to the available alternatives. The Scientific Committee will assess any future modelling efforts critically with regard to the quality of input data, modelling assumptions and realism before deciding if any advice can be given.

The Scientific Committee agreed that the next meeting of the Working Group should focus on assessing modelling results from the Scenario Barents Sea model and possibly the GADGET-based template models for other areas, if they are developed. The Working Group should also consider the feasibility of connecting the multi-species models with simple economic models at that time. Walløe agreed to provide the Scientific Committee with a report on progress in the modelling efforts identified by the Working Group at next year's meeting. The Scientific Committee will assess progress made in modelling and in the collection of input data and decide at that time whether enough progress has been made to warrant another meeting of the Working Group.

8.2 Other matters

Document SC/10/16 described a project, initiated by members of the NAMMCO Scientific Committee, to enable an assessment of the ecological role of harp and hooded seals throughout their distributional range in the Nordic Seas (Iceland, Norwegian, Greenland Seas). 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 (autumn), July/August in 2000 (summer), and February/March in 2001 (winter). Results from analyses of stomach and intestinal contents from captured seals in this particular habitat, which is only a small part of the distributional range, revealed that the diet of both species were comprised of relatively few prey taxa. Pelagic amphipods of the genus *Parathemisto* (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 were 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.

A final survey within the framework of the project will be conducted using R/V"Jan Mayen" in pack ice waters off the east coast of Greenland in September-October 2002. Additional to the dedicated surveys, samples for the project have been obtained from local hunters operating on the east coast of Greenland and from animals taken in by-catches and hunt in Icelandic waters.

Mikkelsen reported that the sampling program for dolphins taken in drives was continuing, and that significant numbers of samples from white-sided dolphins had been collected this year. It is expected that diet and life history analyses will be conducted in the coming year. Víkingsson reported that analysis of samples of white-beaked dolphins from Icelandic bycatch was nearly complete, and that he expected to report the results in the coming year. The Scientific Committee encouraged the timely completion of these programs and the publication.

9. MARINE MAMMAL STOCKS -STATUS AND ADVICE TO THE COUNCIL

9.1 and 9.2 Harp and hooded seals

9.1.1 Update on progress

Haug provided a progress report on an aerial survey for harp and hooded seals in the Greenland Sea which took place during the period 14 March to 6 April 2002. In the Greenland Sea, harp and hooded seals were surveyed by air in 1991 and 1997, respectively. Although not formally established, it has been argued that the period between surveys should not exceed 4 to 5 years. For this reason, new aerial surveys to assess the status of the Greenland Sea population of harp seals and, if possible, hooded seals during their whelping period (March-April) were conducted in 2002. During field work, which included participation of Canadian scientist with substantial experience from similar surveys in the Northwest Atlantic, it soon became evident that logistical restrictions in combination with unusually scattered and wide distribution of the hooded seal pups made it impossible to survey both species simultaneously. Therefore, the survey focussed on harp seals.

One fixed-wing twin-engined aircraft was used for reconnaissance 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 other purposes, such as age staging (also performed along transects over the patches) of the pups to assess the temporal distribution of births. Three harp seal breeding patches were located and surveyed either visually, photographically or both. Analyses of images from the photographic surveys are still in progress. These analyses include participation of Canadian and Russian scientific personnel with experience from similar analyses from harp seal surveys in the Northwest Atlantic and White Sea, respectively. The results from the aerial surveys will be used to estimate the total 2002 harp seal pup production. Subsequently, the status of the stock will be assessed by fitting population models to the pup production estimate.

The Scientific Committee noted the effort to calibrate analysis of the photos between laboratories, and suggested that this was an excellent approach that should be followed for other surveys.

Witting noted that the aerial digital photographic survey off Greenland would produce data on the distribution and abundance of harp seals in open water in that area.

9.1.2 Future work

In a meeting in the ICES Headquarters, Copenhagen, in October 2000, the Joint ICES/NAFO Working Group on Harp and Hooded Seals [WGHARP] decided to arrange a workshop to examine methods of modelling of pinniped populations, with specific focus on North Atlantic harp and hooded seal populations. The group has so far been unable to assess existing pinniped population models and decide upon a standardised series of models. At the workshop, a variety of population models are to be presented and their performance evaluated under different scenarios concerning the availability of data and the degree of uncertainty expected. WGHARP recognises that as more information becomes available on the various harp and hooded seal stocks there will be an increased need to standardise a suite of population models that can most effectively accommodate the range and type of data collected. Topics of the workshop will include, but not necessarily be limited to:

- A review of existing WGHARP models;
- Comparison of other modelling regimes (e.g., the International Whaling Commission's Revised Management Procedure and the US Marine Mammal Protection Act) to the current WGHARP approach.
- Approaches to the incorporation of density dependence into pinniped models.
- Use of simulation to test the assumptions implicit in model parameters.
- Comparison of age-aggregated versus desaggregated models, especially under scenarios where the age structure of the catch is highly skewed.
- Consider the applicability of biological reference points.

Named the ” Workshop to Develop Improved Methods for Providing Harp and Hooded Seal Harvest Advice”, it will be held at the US National Marine Fisheries Science Center in Woods Hole, MA, USA, on 11-13 February 2003 under the convenorship of one of the WGHARP members, Richard Merrick from the US National Marine Fisheries Science Center.

WGHARP has not met since October 2000, but is due to meet in Arkhangelsk, Russia from 1–5 September 2003 to:

- review of recommendations from the “Workshop to Develop Improved Methods for Providing Harp and Hooded Sea Harvest Advise”, possibly also apply recommended models to existing data on harp and hooded seals;
- review and discuss existing methods applied in seal diet and consumption studies;
- review results from surveys of the 2002 harp seal pup production in the Greenland Sea.

Other elements of the terms of references must await formal requests, forwarded to WGHARP through the ICES system.

9.3. Harbour porpoise

9.3.1 Update on progress

Haug reported that feasibility studies into assessing the abundance of harbour porpoise in Norwegian inshore waters have been undertaken in 2000 and 2001. This involves combined line/strip transect cruises in nearshore waters. Analyses of the data are presently underway.

9.3.2 Future work

The Scientific Committee noted with interest that the small cetacean survey (following SCANS) as been scheduled for 2004 or 2005, and that the Faroe Islands and Norway have planned to participate.

9.4 and 9.5 Narwhal and Beluga

9.4.1 Update on progress

Narwhal

Narwhals occur in four concentrations areas in West Greenland: Disko Bay, Uummannaq, Melville Bay and Inglefield Bredning. Surveys in all these areas will have been attempted at the end of 2002, but for the Melville Bay and Uummannaq areas, the surveys may have to be repeated in 2003.

Capturing of whales for satellite tracking has been attempted in Disko Bay (1998-1999), Uummannaq (1995-1996) and Inglefield Bredning (2002). Live capturing of narwhals was not feasible for Uummannaq and Disko Bay. A new attempt for Inglefield Bredning will be launched in August 2003. .

Genetic studies have been conducted in all four areas and results have been published, but it is uncertain how useful the results will be for a future assessment.

In Canada the Department of Fisheries and Oceans is presently surveying a number of stocks of narwhals and there will, within the next couple of years, be more survey data available. Narwhals have been tracked from Eclipse Sound and Prince Regent Inlet but none of them went to West Greenland. Live capturing was attempted in 2002 in Admiralty Inlet and will be tried again in 2003. Aside from the major aggregations there are several smaller stocks of narwhals in Canada that may contribute marginally to the harvest in West Greenland. However at present there is no sure indication of a direct contribution from to the Greenlandic catch from Canadian stocks.

Beluga

Some new results from satellite tracking of belugas have become available since the Scientific Committee last performed an assessment in 2001, but the information does not provide a basis for altering the present advice. The next survey of belugas on the wintering ground in West Greenland will be conducted in March 2004. Results from this survey will – assuming successful completion – be available for revising the present advice in the autumn of 2004.

The Scientific Committee noted with satisfaction the progress in implementing a quota system for beluga and narwhal in Greenland, but further noted that recent harvest figures for Greenland indicate that little or no reduction in catch has taken place. The Committee has advised on 2 occasions (2000 and 2001) that the stock is substantially depleted and that present harvests are several times the sustainable yield, and that harvests must be substantially reduced if the stock is to recover. The Committee stressed that the apparent delay in reducing the catch to about 100 animals per year will result in further population decline and will further delay the recovery of this stock.

9.4.2 Future work

The Council has recommended that the Scientific Committee should concentrate its assessment efforts on the West Greenland narwhal in the near term, and that this assessment should be done jointly with the JCNB if possible. A future assessment of narwhals in West Greenland may require two consecutive meetings to answer specific questions and to set scenarios for runs of population models. While assessment work could potentially begin as early as Spring 2003, when the results of the Inglefield Bredning survey should be available, the Scientific Committee considered it advisable to wait until 2004, when surveys from other areas will have been completed and analysed. A subsequent meeting, probably in 2005, could deal with both narwhal and the new survey data for beluga which should be available at that time. Planning for future assessments will have to be done in conjunction with the Scientific Working Group of the JCNB, of which Witting is Chairman. He agreed to liaise between the two groups to find the best way to carry the assessment forward.

9.5 Fin whales

9.5.1 Update on progress

In 2002 the Council clarified its previous request for advice on fin whales, asking that the Scientific Committee continue with its assessments of fin whale stocks in the areas of interest to NAMMCO countries with existing and new information on abundance and stock delineation as it becomes available.

An estimate of the abundance of fin whales from the NASS-2001 survey has been completed (see Section 10.1). The Committee noted that abundance estimates from the Norwegian survey area of the NASS-1995 survey have not been published, and estimates from subsequent surveys in the Norwegian area have not yet been produced. The Committee recommended that these estimates be completed on a timely basis.

Bloch reported that she is continuing her efforts to review the catch series for fin whales in Faroese waters through archival research. Some discrepancies with the IWC catch database have been identified and corrected.

Efforts to tag fin whales with satellite-linked tags have continued in the Faroes, Greenland and Iceland. In the Faroes, 12 tag deployments have been made in the past 2 years, of which 2 have transmitted data. One of these animals moved into the waters west of Bay of Biscay, and had a tag life of 116 days, perhaps the longest recorded for this species. Bloch reported that further tagging would not be carried out until there was some indication that the success rate had improved. There have been some successful deployments in Greenland but none in Iceland.

Collection of tissue samples for genetic analysis has continued in the Faroes, Greenland, and Norway. In the Faroes and Norway, samples are collected through a biopsy program, while in Greenland samples are taken from the annual catch. Iceland has a large collection of tissue samples from historical catches, however virtually all of these are from western Iceland. The Committee noted that satellite tagging had indicated an apparent connection between fin whales in Faroes and in the waters near Spain and urged the addition of tissue samples from fin whales in these waters to

ongoing studies on stock structure of North Atlantic fin whales. Samples may be available from the historical catch, or could be taken by biopsy.

9.5.2 Future work

The Scientific Committee noted that the success rate of deploying satellite tags on fin whales and other large whales was low and variable between research teams. There are several research groups working on large whale tagging in NAMMCO member countries, the USA, Japan and other countries, and the field is quite competitive. The Committee decided to establish an intersessional correspondence group to:

- identify progress in satellite tagging made in NAMMCO member countries and elsewhere;
- explore the technical aspects of satellite tagging, including deployment systems;
- briefly consider what tagging experiments have been done and the rates of success;
- recommend ways to further the development and success of this technique in NAMMCO member countries.

Víkingsson, Heide-Jørgensen, Mikkelsen and Nils Øien from Norway were appointed to serve on the committee, with Mikkelsen as chairman. The Committee will report their findings at next years meeting of the Scientific Committee.

The Scientific Committee considered that the new abundance data for the Faroese and Icelandic areas could allow the assessments for these areas to be updated in the coming year. An assessment of fin whales in the Norwegian area could be attempted if abundance estimates for the area are completed. One idea might be to co-schedule a fin whale assessment meeting with a minke whale assessment meeting, as many of the same people would be involved. Consideration should be given to contracting an update of the genetic analysis including new samples from the Faroes.

9.6 Minke whales

9.6.1 Update on progress

In 2002 the Council recommended that the Scientific Committee should complete an assessment of Central Atlantic minke whales once new abundance estimates from NASS-2001 become available.

Estimation of abundance from the 2001 aerial survey and a reanalysis of the 1987 aerial survey data are presently being conducted under contract to the Research Unit for Wildlife Population Assessment (RUWPA) at the University of St Andrews. Gunnlaugsson reported that analysis of the ship survey data is ongoing. Analysis of the 1996-2001 series of Norwegian sightings surveys, which includes part of the Central Atlantic stock, has been completed and reported to the IWC. Witting reported that an aerial digital photographic survey of minke whales and other species was ongoing in West Greenlandic waters, and would be repeated in 2003.

Víkingsson reported that satellite tags had been deployed on 2 minke whales this year, and one was still transmitting.

Walløe reported that genetic analyses of the large number of samples from the Norwegian catch were ongoing. However more samples from surrounding areas, including the Faroes and Iceland, are required to refine the analysis. The Scientific Committee recommended that tissue samples be collected from these areas by biopsy or other means.

9.6.2 Future work

The Scientific Committee considered that a new assessment of the Central Atlantic stock could be conducted after the Working Group on Abundance Estimates has considered the new estimates from the Icelandic aerial survey and the Icelandic and Faroese ship surveys from NASS-2001.

9.7 White-beaked, white-sided dolphins and bottlenose dolphins

9.7.1 Update on progress

An abundance estimate for primarily white-beaked dolphins from the NASS-2001 Icelandic aerial survey has been produced (see 10.1), and estimates from previous aerial surveys are in progress. Estimates from the ship surveys have not been developed. Witting reported that the digital photographic aerial survey presently being conducted in West Greenland should produce data suitable for abundance estimation for dolphins.

Sampling programs from Icelandic bycatch of whitebeaked and the Faroese drive hunt whitesided and bottlenose dolphins have been conducted, and reports on life history and general ecology should be produced in the coming year. Norway will be initiating a sampling program involving the collection of approximately 60 whitebeaked dolphins for life history, genetic and feeding analyses. In addition biopsy samples are collected during sightings surveys.

9.7.2 Future work

At this point the Scientific Committee considered that there was still insufficient information on abundance, stock relationships, life history and feeding ecology to go forward with the requested assessments for these species. This may become feasible once further abundance estimates from the Icelandic and Faroese areas are produced, and the ecological studies in the Faroes, Iceland and Norway are completed. The Scientific Committee recommended that these studies be completed in a timely manner

9.8 Grey seals

9.8.1 Update on progress

Víkingsson reported that a survey of grey seals around Iceland would be conducted in fall 2002. Haug informed the Committee that abundance surveys of grey seals are conducted in Norwegian waters by ship, and that quotas are set using minimum estimates of abundance. He noted the need for more stock delineation work on this species.

9.8.2 Future work

In 2002 the Council requested that, given the apparent stock decline in Iceland, an

apparent increase in Southwest Norway and in the United Kingdom, and the fact that this species interacts with fisheries in three NAMMCO member countries, the Scientific Committee provide a new assessment of grey seal stocks throughout the North Atlantic. Dr. Kjell Nilssen has accepted the position of chairman of the new Grey Seal Working Group. The general terms of reference of this Working Group will be:

- to assess the status of greys seals around Iceland, the UK, the Faroes, Norway, the Russian Federation, the Baltic, Canada and other areas;
- survey methods;
- stock delineation (genetics, temporal and geographical distribution);
- recommendations.

The Scientific Committee recommended that relevant international experts be invited to participate in the Working Group. In addition, working papers on stock status and other topics should be requested well in advance of the meeting. It was decided that the meeting should be held in early April in Iceland.

9.9 Harbour Seals

9.9.1 Update on progress

Haug informed the committee on the progress of the distemper outbreak in European harbour seals in 2002. Over 11,000 harbour seals have been reported killed by the outbreak so far, and if it follows the pattern of the 1988 outbreak, a large proportion of the population will be lost. The outbreak has affected seals in southern Norway but not so far in Iceland or Greenland.

9.10 Humpback whales

9.10.1 Update on progress

New abundance estimates from the NASS-2001 aerial and ship surveys are presently under development (see 10.1), and there is evidence from the Icelandic aerial surveys that the stock is increasing at a rapid rate in that area. There has also been an increase in both incidental and survey sightings around the Faroes. The aerial digital photographic survey being conducted in West Greenland should provide an estimate of abundance in that area.

Víkingsson reported that efforts to obtain photographs and biopsy samples from eastern Icelandic waters were continuing, as had been recommended last year. This year the first photographic match was made between one humpback from Icelandic waters and the Cape Verde breeding area. In Greenland, 4 satellite tags have been successfully deployed on humpback whales this year.

9.10.2 Future work

In 2002 the Council recommended that the Scientific Committee complete abundance estimates for this species as a high priority, and should also consider the results of the "Years of the North Atlantic Humpback" (YoNAH) project as it pertains to member countries in providing advice for this species.

The Scientific Committee noted that abundance estimates are being completed for this species as a high priority. Information from the YoNAH project, pertaining to stock

delineation, migration, biological parameters, and abundance both North Atlantic-wide and in feeding areas has been published (Smith *et al.* 1999, Larsen and Berubé 2000, Larsen and Hammond 2000, EC YoNAH 2001, Palsbøll *et al.* 2001, Stevick *et al.* 2001). The Scientific Committee has noted previously (2001) that abundance estimates from the NASS-95 survey appear to conflict with the results of the YoNAH project, and comparison with the estimates from NASS-2001 should be of great interest.

10. NORTH ATLANTIC SIGHTINGS SURVEYS

10.1 NASS-2001

10.1.1 Report of the Working Group on Abundance Estimates

The NASS-2001 survey was conducted in June - July 2001. The main purpose of the meeting was to review survey reports and abundance estimates from the survey, particularly for the target species minke and fin whales. Many of these estimates were only partially complete, so the Working Group was to recommend additional analyses to be conducted. A secondary objective was to evaluate the survey design and procedures used, and make recommendations for future surveys. Finally, the Working Group was asked to plan and schedule the publication of the results from NASS-2001, and those from previous surveys that had not already been published.

Minke whales

No abundance estimate was available for minke whales from the Faroese and Icelandic ship surveys. However the coverage and distribution of sightings in the Icelandic survey area may necessitate some non-standard analyses. Because of weather and ice related revisions to the survey plan in the northern and north-western blocks, the coverage probabilities were substantially higher in some parts of strata than in others. Sightings of minke whales were highly clustered close to the northern and western edges of the western and north-western blocks, presumably in association with the pack ice edge. This corresponds to an area of high coverage probability. The Scientific Committee recommended that a spatial analysis be considered for these data. However, given that the ship survey will likely contribute relatively little to the total estimate for the Central stock, the simpler alternative of post-stratification may be adequate to reduce the potential bias. Gunnlaugsson and Pike reported that both a traditional line transect analysis and an analysis using the methodology developed by Norway (Schweder *et al.* 1997) were being carried out on these data.

Stratified cue counting methods were used to calculate a preliminary estimate from the Icelandic aerial survey. The best estimate of minke whale abundance in the survey area was derived using only the data of the best observer and a cueing rate of 53 cues per hour (no variance estimate), 40,115 whales (95% CI 24,660 to 65,257) for the entire area. Known biases for this estimate include minke whale cues missed by observers (negative bias) and error in estimating radial distance (positive bias). An analysis that corrects for these biases is presently being conducted under contract with the RUWPA group at the University of St Andrews.

An analysis of trends in distribution and abundance of minke whales from aerial surveys conducted in the coastal waters of Iceland in 1986, 1987, 1995 and 2001 was considered. Line transect density was used as an index of relative abundance, and all datasets were treated in an identical manner so that any trend signal would not be masked by analytical differences. The distribution of minke whales was very stable from year to year, with highest densities in the SW, N and SE waters of Iceland. Relative abundance showed a significant increase in the area to the N of Iceland, and moderate but non-significant increases in the high-density area in SW Iceland (Faxaflói), NW Iceland and in the survey area as a whole, over the period. The Scientific Committee concluded that the abundance of minke whales around Iceland has been stable or shown a moderate increase over the period. The apparent increase in relative abundance in the area to the N of Iceland is consistent with population growth after cessation of catching, however other factors, such as immigration from other areas, may also be involved. There are also indications of better feeding conditions off northern Iceland in 2001 than in previous surveys.

An analysis of data from the Icelandic and Faroese ship surveys is presently in progress.

Fin whales

The distribution of sightings of fin whales was more even than in earlier surveys, particularly in the blocks west of Iceland, where the distribution in previous surveys was more concentrated around the continental slopes. Double platform data collected indicated that the proportion of whales seen by the primary observers close to the trackline was close to 1 for this species, and that a correction for whales missed would not increase the estimate substantially while increasing the variance. The estimate for the total area of 25,352 is higher and has a lower CV than estimates from equivalent areas from past NASS surveys (Table 1). While some of this increase may be related to increases in survey efficiency, this factor alone likely cannot explain the observed increase since 1987. Stock increase, immigration from other areas, and/or variation in distribution between years may also be involved.

The Scientific Committee concluded that this estimate is likely to be only slightly negatively biased by perception and availability biases, and accepted that correcting for perception bias was not likely to be worthwhile. The four NASS ship surveys carried out since 1987 provide an excellent time series of abundance for this species. It was therefore recommended that a more complete analysis of changes in abundance over all the NASS surveys be conducted. This may require some re-analysis of past survey data as the coverage has changed between surveys.

Pike reported that he had begun "fine tuning" the estimate by using separate perpendicular distance functions for each of the 4 vessels involved in the survey. This will result in some slight changes to the individual block estimates, but virtually no change to the overall estimate. These results will be presented to the Working Group on Abundance Estimates at their next meeting.

Table 1. Abundance of fin whales from the NASS-2001 ship survey. *n*- number of sightings; *L*- effort; *N*- abundance estimate.

Block	Area (nm)	*n*	*L* (nm)	*N*	CV (%)	95% CI	
Icel.SW	190,577	31	1,169	2,723	27.87	1,480	- 5,009
Icel.W	154,692	271	2,424	10,800	15.20	7,862	- 14,836
Icel.NW	28,154	144	616	5,513	38.81	2,274	- 13,370
Icel.N	31,781	38	556	1,522	53.13	449	- 5,155
JanMayen	145,847	47	1,791	2,719	38.13	1,196	- 6,180
Faroe Isl.	117,500	62	2,457	2,074	27.39	1,139	- 3,777
Combined	668,551	593	9,013	25,352	12.71	19,576	- 32,831

Humpback whales

A preliminary line transect estimate for humpback whales from the 2001 Icelandic aerial survey has been completed. Sightings of humpback whales were highly concentrated off north-eastern Iceland and to a lesser extent off south-western and northern Iceland. A relatively high proportion of sightings close to the trackline by the secondary observers were duplicated by the primary observers, indicating that perception bias is low but not absent for this species. The total number of humpback whales in the search area was estimated to be 3,057 (95% CI 1,727 to 5,410), with NE Iceland accounting for over half of this number. However this estimate has a negative bias because of perception bias and, probably more importantly, animals missed because they were diving when the plane passed.

Sightings from the NASS-2001 ship survey were also highly clustered around NE and W Iceland within the aerial survey block, but substantial numbers were also seen in areas farther offshore. More sightings were made in the Faroese block than in previous surveys. No estimate has been derived from these sightings as yet.

The contagious distribution of humpback whales seen in both the aerial and ship surveys may make spatial modelling a suitable analytical approach. It is likely that a spatial model would provide a more precise estimate and might enable some ecological interpretation of the observed distribution. A spatial analysis of the 2001 and 1995 aerial and ship survey data is now being conducted under contract to RUWPA at the University of St Andrews.

An analysis of the trend in encounter rate over the course of the 4 Icelandic aerial surveys carried out since 1986 showed an increase of 11.4% (SE 2.1%) per year over the period in the survey area. Encounter rates for other species did not change much over the period, so it seems unlikely that the increase for humpback whales can be attributed to changes in survey efficiency. This rate of increase is in accordance with that of 11.6% over the period 1970 to 1988 in recorded sightings humpback whales by whalers operating west of Iceland reported by Sigurjónsson and Gunnlaugsson (1990). Humpback whale sightings have also increased over the course of the NASS ship surveys conducted since 1987.

There has been almost no catch of humpback whales around Iceland since the first stage of Icelandic whaling came to an end in 1915 (Sigurjónsson and Gunnlaugsson 1990). Therefore, stock recovery is one plausible explanation for the trend, however the observed rate is on the edge of biological plausibility. Immigration from other areas may also be playing a role. The Yonah study (Palsbøll *et al*. 2001) has shown that there are at least 2 breeding populations of humpbacks in the North Atlantic, and that the whales around Iceland and Norway are a mixture of the 2 groups. It is possible that the stocks are growing at different rates, accounting for the apparent recent high growth rate around Eastern Iceland.

There has been very little sampling of humpback whales from E Iceland. Víkingsson noted that genetic and photographic sampling was planned for summer 2002, and would be continued if successful.

Lagenorhynchus dolphins

There were large numbers of dolphin sightings in the Faroese and Icelandic ship surveys, and in the Icelandic aerial survey. A preliminary abundance estimate for the Icelandic aerial survey has been completed. Species identification was uncertain but 96% of the sightings were identified as white-beaked dolphins, with the rest being of unknown species identity. The high proportion of white-beaked dolphins is consistent earlier surveys and other information from the area. The distribution of dolphins was consistent with earlier surveys, with animals being concentrated in N central, SW and SE Iceland, however dolphins were found almost everywhere in the survey area. Group size estimation was somewhat uncertain but there was no apparent bias in group size estimation with perpendicular distance. The total number of dolphins in the search area was estimated to be 20,444 (95% CI 12,714 to 32,874). This estimate is biased downwards both by perception and availability biases. There are duplicate data that might be used to correct for perception bias, but this has not been done yet. The Scientific Committee recommended that further analyses that incorporate the duplicate data be completed. It was also recommended that the other aerial surveys be analysed in a similar manner to look for temporal trends.

Virtually all sightings in the Faroese ship survey block were confirmed as white-sided dolphins. Some of these sightings were in an area in which white beaked were also seen on the aerial survey. This should be investigated further. Most sightings from the Icelandic vessels were of white-beaked dolphins, but many sightings were not identified to species and it was considered that species identification was uncertain even for those that were identified. Tracking of dolphin groups by the secondary observers was not very successful in either the Faroese or Icelandic surveys, so there is insufficient information to correct for availability bias or responsive movement.

The Working Group reiterated its conclusions from 2000, that while an analysis of the shipboard dolphin data from this and earlier surveys is feasible, the problems of uncertain species identification, uncertain group size estimation, and possible responsive movement of these species would present significant problems for abundance estimation. As a first step, the Icelandic members agreed to inspect the data for these species to determine if further analyses are likely to be useful. If so, an

analysis that assigned species identification probability using relevant explanatory variables should be considered.

Pilot whales

A total of 87 sightings of 1,185 pilot whales were made by the Icelandic and Faroese vessels, more than in 1995. The Scientific Committee considered that, given the relatively high number of pilot whale sightings in the 2001 survey, and abundance estimation was worthwhile and should be conducted. Pike agreed to carry out the analysis. It was also noted that a recent successful application of satellite tags in the Faroe Islands will provide data with which to correct for availability bias for this species.

Sperm whales

A calculation of sperm whale abundance from the 2001 Icelandic and Faroese shipboard surveys was considered. For the first time data was collected in such a way that a cue count, using terminal dives as a cue, was feasible. The vessel to stopped or slowed down if it was heading to within 0.5 nm of a sperm whale to avoid triggering responsive cues, and the position of the cue relative to where the vessel would have been had it continued was used in the analysis. In addition to the cue count, which included only those animals that displayed a cue, a line transect estimate that included those animals that were visible on the surface as the vessel passed abeam was calculated. It was assumed that sperm whales cued twice per hour, and line transect estimate was corrected by assuming that sperm whales spent 20% of the time visible at the surface. For the Icelandic area, the weighted average of the two estimates was 9,477 (CV 0.406). A cue count estimate was not possible for the Faroese area because the positions of terminal dives were not recorded consistently. The ratio between the combined estimate for the Icelandic area, and a line transect estimate that included all sightings (1.41), was used to correct the Faroese line transect estimate to 1,708 whales. The combined estimate for the entire area was 11,185 (CV 0.34). Data from past Icelandic harvests has shown that only male sperm whales are found in these waters.

In discussion the Scientific Committee agreed that the methodology used was theoretically and practically valid. The cue rate and proportion of time spent on the surface used to calculate the estimate are of course crucial. While no data has been collected from this area, data collected from other areas could be applied to provide a better estimate of these parameters. Radio tagging studies in North Atlantic waters will however be required to provide more reliable estimates.

Bottlenose whales

More bottlenose whales were sighted in both the Icelandic and Faroese surveys than in previous surveys. As NAMMCO has used a line transect estimate from previous NASS surveys in an assessment of this species, it was considered worthwhile to proceed with a line transect estimate for this species, while recognising that it will have a substantial negative bias due to availability bias with this deep-diving species. In this regard the availability of dive data from Canadian waters was noted. Pike agreed to carry out the analytical work.

Killer whales

There were 36 sightings of killer whales in the Icelandic shipboard survey, and 8 in the Faroese block. The Scientific Committee considered that an abundance estimate derived from these sightings was unlikely to be of use. However the distribution should be compared with that seen in earlier surveys.

Blue whales

The Icelandic ship survey produced 29 sightings of blue whales, while 9 sightings were made in the aerial survey. While this is likely too few to derive a meaningful abundance estimate, it might be useful to compare encounter rate between surveys to determine if there is any evidence of a trend in relative abundance. However it was noted that such a trend might be confounded by between-survey differences in the effort dedicated to differentiating blue and fin whales. More effort was made to discriminate the species in 2001 than in earlier surveys.

Evaluation of survey methodologies

The Working Group provided a detailed evaluation of the methodologies used in the ship and aerial surveys, and a list of recommendations for improvements. The Scientific Committee considered that the Report and the contributory working papers should serve as an excellent guide for the planning and conduct of future NASS surveys.

Ship surveys

A major problem with the set-up on the Faroese vessel was that the tracker platform was lower than the primary platform. Problems were also experienced with vibration on the tracker platform, making it difficult and uncomfortable to use the binoculars. The primary observers were instructed to search for both the primary species, minke and fin whales, which required them to search at greater distances from the platform than they would have if only minke whales had been targeted. The Buckland-Turnock (BT) design requires the tracker to search substantially further than the primary observers. This requirement was compromised on both the Faroese and Icelandic vessels. Few trackings of minke whales were made on the Icelandic vessels, probably because weather conditions prevented the trackers from seeing small whales at large distances, and possibly also because the observers tended to focus their search on the target fin whale. The application of the BT method was therefore not successful in terms of correcting for responsive movement and availability bias, although the duplicate data will still be useful in correcting for perception bias, and was felt to be useful in keeping observers alert.

The Scientific Committee considered that the application of the BT methodology was problematic in a combined survey for large and small whales, which did not restrict primary search effort to be substantially closer to the vessel than tracker search effort. On these surveys, the BT method was compromised, and few trackings were made. If the BT method was applied as intended, with the primary platform searching close to the platform and the tracker platform searching farther away, it is still likely that sufficient sightings of large whales would have been made.

Another possibility would be to use symmetric platforms, with all observers tracking whales and recording cues and tracking whales, as in the Norwegian minke whale surveys. Duplicate matching would be done after the survey rather than in the field. Initial sightings could be classified by distance to derive corrections for responsive movement and availability bias using the method of Palka and Hammond (2001). Such a methodology would benefit from automated timing of cues, as is done in the Norwegian surveys. The effort put into tracking might also reduce the total number of sightings, but this might not be problematic as the effort applied is increased by fully utilising the data from both platforms.

It was emphasised that the double platform methodology in general was successful and will prove useful particularly in refining the estimates for minke whales and other smaller species. Further effort should be devoted to the automation of data recording and entry so that observers can be better monitored by the cruise leader in the field. Finally, special attention must be paid to the design of platforms to reduce vibration, improve visibility and increase observer comfort.

The Scientific Committee noted that sharing of survey platforms with the redfish survey had apparently been successful. International redfish surveys will be carried out over similar areas on a 3-year rotation, and cover a larger area to the south and west of the NASS-2001 survey area. The Scientific Committee recommended to further investigate the possibility of using future redfish surveys to conduct or extend cetacean surveys by sharing platforms with all participating vessels in the redfish survey.

Aerial surveys

A fundamental consideration was whether cue counting from an airplane was the best approach to estimate minke whale abundance in Icelandic nearshore waters. The methodology is very demanding of observers, sensitive to distance estimation error and differences in sighting patterns between observers, although these factors can be accounted for in the analysis. There have been problems with the conduct (1995, 2001) and analysis of data (all years) from the surveys that make comparisons of absolute abundance between surveys difficult.

The Scientific Committee, however, considered that that cue counting from an airplane should be an effective methodology for minke whales. Correcting line transect estimates for availability bias is more difficult than for doing so for cue counting. The Scientific Committee concluded that with the practical recommendations for improvements in equipment and procedures contained in the Working Group Report, cue counting was still the best available methodology for minke whale surveys in this area.

The Scientific Committee agreed that the possibility of using an aerial digital photographic survey should be considered, once this technique has been fully tested for large whales in Greenland.

10.1.2 Future work

The Scientific Committee agreed that completion of the following analyses should be of high priority for the Working Group:

i. Aerial survey estimate of minke whales around Iceland from 2001 and 1987, accounting for bias due to measurement error and whales missed by observers. This work is presently being pursued under contract to RUWPA.
ii. Spatial analysis of humpback whale distribution and abundance, from 2001 and 1995 ship and aerial surveys. This work is presently being pursued under contract to RUWPA.
iii. Abundance estimate of minke whales from Faroese and Icelandic ship surveys, 2001. This is in progress;
iv. Abundance estimates for dolphins from the 2001 and earlier surveys;
v. Abundance estimates for pilot whales and northern bottlenose whales from the 2001 survey.

It was anticipated that all or most of this work could be completed in time for a meeting of the Working Group early in 2003.

10.2 Status for analyses and publications from previous NASS surveys

Although the idea of publishing a volume on the North Atlantic Sightings Surveys (NASS) was dropped in 2000 by the Scientific Committee, it was revived in 2001 following the NASS-2001 survey. The Scientific Committee then directed the Working Group on Abundance Estimates to devise a plan for the publication of results from NASS-2001 and earlier surveys.

The Working Group agreed that a special volume on the NASS surveys in general would be of great interest to many researchers. Four NASS surveys have been conducted, over a long enough time frame that temporal trends in distribution and abundance may be detectable. The volume therefore should not merely report abundance estimates from the later surveys, but should synthesise results from all the NASS surveys to elucidate temporal and spatial patterns. It was considered that the volume could best be organised by species, with contributors using information from all the NASS surveys regardless of national affiliation. Nils Øien agreed to act as editor for the volume.

Subsequent to the meeting, Pike and Øien drafted a list of prospective papers that could be developed for such a volume and this was presented to the Scientific Committee. Given that none of these papers have yet been written, and some will require further data analysis, this volume could not be completed before sometime in 2004. The Scientific Committee supported the idea of proceeding with this new volume of NAMMCO Scientific Publications, which will be the sixth in the series. Øien and Pike have agreed to edit the volume.

11. NAMMCO SCIENCE FUND

At the 9th meeting of the NAMMCO Council in 1999, the Chairman of the Scientific Committee, Dr Mads Peter Heide-Jørgensen, proposed that the Scientific Committee be given the option of conducting its own research with funding provided by the

Council. This would facilitate closer co-operation between members intersessionally, and enable the Scientific Committee to play a more active role in addressing questions put to it by the Council. Projects could include the development of new assessment procedures, addressing key questions on stock delineation, multi-species interactions, or generally to address the priorities of both the Scientific Committee and the Council. Subsequently the Scientific Committee developed a full proposal for such a Science Fund, with examples of projects that would address issues put to it by Council, and could be supported within the proposed funding level of the Science Fund. The proposal for the Science Fund, along with these examples of projects that could be conducted under the program, was presented to the Council at their 11th meeting in February 2002.

In discussing this matter, the Council noted that the establishment of such a fund would reduce the funding available to National Research Institutions, and would result in no net increase in funding for marine mammal research. The Council therefore decided not to support the establishment of a NAMMCO Science Fund. The Council did however acknowledge that a better way must be found to convey the priorities of NAMMCO to National Research Institutions.

The Scientific Committee expressed its profound disappointment that a Science Fund could not be established. As the intention of the Fund was to fund research that would facilitate and accelerate the response of the Scientific Committee to requests put to it by the Council, the Committee noted that its recommendations for research must be acted upon by national research institutes if the requests of the Council are to be fulfilled in a timely manner.

12. DATA AND ADMINISTRATION

The *Rules of Procedure for the NAMMCO Scientific Committee* were accepted by the Council at their second meeting in 1993. Since that time there have been changes both to the Scientific Committee and the Secretariat that necessitate some minor changes to the *Rules*. In addition, some points in the *Rules* required clarification and explanation or need to be updated due to subsequent decisions of the Council. A new draft of the *Rules* was prepared by the Scientific Secretary and approved by the Scientific Committee in 2001. The proposed draft was then submitted to the Council for approval.

Two minor revisions of the *Rules* were required by the Council. Firstly, the Council has found the Executive Summary of the Report of the Scientific Committee useful and wishes to see this practice continued. Secondly, some member countries need a period of at least 3 months to review and consider the contents of the Report of the Scientific Committee before they meet in Council. Therefore the *Rules* have been revised so that meetings of the Scientific Committee must be held at least 14 weeks before meetings of the Council.

The final *Rules of Procedure for the NAMMCO Scientific Committee*, with the associated Annex 1 *Guidelines for the Release of Documents by the Scientific Committee*, were approved by the Committee and are included as Appendix 4.

The Scientific Committee expressed some concern that the long time gap between meetings of the Scientific Committee and the Council, during which the Report of the Scientific Committee cannot be distributed, means that some of the recommendations of the Committee cannot be acted on in a timely manner. It also prevents Committee members from bringing the findings of the Committee into other fora where they may be of great interest, if meetings occur in this period. The Committee urged the Council to find a way to approve the Report in a timely manner, perhaps via an intersessional meeting.

13. PUBLICATIONS

13.1 NAMMCO Scientific Publications

Three volumes of NAMMCO Scientific Publications have now been published: Vol. 1 *Ringed seals in the North Atlantic*, Vol 2 *Minke whales, harp and hooded seals: Major predators in the North Atlantic ecosystem*, and Vol. 3 *Sealworms in the North Atlantic: Ecology and population dynamics*. The latter was published late in 2001 and has been distributed to libraries, research institutions and to journals for review.

The following volumes are presently in progress:

Belugas in the North Atlantic and the Russian Arctic. ed. Heide-Jørgensen, M.P. and Wiig, Ø. *NAMMCO Sci. Publ.* 4.
This volume is in the final stages of publication and should be out in October.

Harbour porpoises in the North Atlantic (no title chosen yet). ed. Haug, T., Desportes, G., Víkingsson, G. and Witting, L. *NAMMCO Sci. Publ.* 5.
At the time of this meeting all papers for this volume have been received for final technical editing and publication. The volume will contain 4 keynote papers and 12 papers in the 4 theme areas. It is anticipated that the volume will be out early in 2003.

In addition the Scientific Committee has decided to proceed with a volume on the North Atlantic Sightings Surveys (See section 10.2).

14. BUDGET

The Scientific Secretary presented a draft budget for the Scientific Committee for 2002. He noted that the budget allocation of the Scientific Committee was utilised for the most part for funding invited experts to participate in Working Group meetings, and for contracted analyses. This year over half of the budget allocation is being used to fund contract analyses of NASS data.

At least 4 working groups are expected to be active in 2003 (see 15.2), and some contract work will be necessary to support these working groups. These costs might exceed the usual budget allocation of the Scientific Committee.

15. FUTURE WORK PLANS

15.1 Scientific Committee

It was decided that Greenland shall host the next meeting of the Scientific Committee in November 2003, at a location yet to be determined.

15.2 Working groups

Working Group on Grey Seals

The Working Group will meet early in April 2003 in Iceland. Dr Kjell T. Nilssen is chairman.

Working Group on Abundance Estimates

The Working Group will meet early in 2003 at a time and location to be determined. Dr Nils Øien will continue as chairman.

Working Group on North Atlantic Fin Whales

The Working Group will meet in November 2003, immediately before the meeting of the Scientific Committee and in association with the new Working Group on North Atlantic Minke Whales. Víkingsson is chairman.

Working Group on North Atlantic Minke Whales

The Working Group will meet in November 2003 in association with the Working Group on North Atlantic Fin Whales. A chairman will be appointed intersessionally.

Working Group on Marine Mammal - Fisheries Interactions

Walløe will provide the Committee with a report on progress in modelling efforts, at which time the Committee will decide if another meeting is warranted. It is anticipated that the next meeting will likely be held in 2004. Walløe will continue as chairman.

Working Group on the Population Status of North Atlantic Narwhal and Beluga

The Working Group will likely meet in 2004 to conduct assessment work on narwhals. If possible the meeting should be held jointly with the Scientific Working Group of the JCNB.

Satellite Tagging Correspondence Group

This group will meet by correspondence under the chairmanship of Mikkelsen, and report back to the Scientific Committee at their meeting in 2003.

Advice Requests Correspondence Group (see 15.3.1)

This group will meet by correspondence and report back to the Scientific Committee by correspondence by late January 2003. Their approved report will be used to provide advice to the Council on the information required in requests for advice when the Council meets in March 2003.

15.3 Other matters

15.3.1 Provision of advice on sustainable catch to Council

In the past the Scientific Committee has been asked to provide assessments and advice on sustainable catch for several species including killer whales, bottlenose whales, beluga, harp and hooded seals, ringed seals and walrus. Recently the Council of NAMMCO has given the Scientific Committee additional requests for advice about sustainable catch levels for Central Atlantic minke whales, fin whales, narwhal and grey seals. It would appear then that the provision of advice on sustainable catch will be a major near-term activity of the Scientific Committee, and that this activity can be expected to increase in the future. Pike presented a discussion paper (SC/10/15) on ways the Scientific Committee might improve and enhance the provision of advice to the Council.

A review of requests for advice from the Council shows that they have varied quite widely. In cases where a "general" stock assessment was requested, i.e. for Central Atlantic minke whales, bottlenose whales, and pilot whales, the resulting advice given by the Scientific Committee was also quite general in nature with regard to catch options. Generally the main conclusion is that present (or past) catches are/are not sustainable. No advice is offered on the possible effects of other harvest options.

More specific requests, which explicitly mention potential catch levels, have been made for fin whales. The resulting advice is more satisfactory in that it provides stock forecasts for these catch levels. On the other hand, there has been no definition of an "acceptable" level of risk of stock decline, so this has been left to the judgement of the Scientific Committee. The request for West Greenland beluga specified catch options under "different management objectives", but did not say what these objectives might be. The Committee specified a paramount objective of halting the decline of this stock.

It is apparent that more specific and detailed requests for advice from the Council result in more useful advice from the Scientific Committee. Focussing on specific management goals for the stock, catch levels and acceptable levels of risk enables the development of models that take these factors explicitly into consideration. With very general requests (e.g. Central Atlantic minke whales), the Scientific Committee can offer advice on the probable effect of past catches, and of future catches of similar levels, but cannot advise on any appropriate level of catch because management objectives are not known. In contrast, when the Scientific Committee works with a specific management objective (e.g. West Greenland beluga), they can offer very specific advice that can be easily translated into management action.

It would appear that relatively few organisation involved in fishery management actually use a well-defined management procedure. Examples considered included the Revised Management Procedure, Potential Biological Removal and harp and hooded seal advice provided by ICES. The use of an explicit and documented management procedure or procedures would have some advantages for the Scientific Committee and NAMMCO as a whole. A management procedure takes most of the "judgement" out of management decisions, making them more defensible in terms of conservation. Management procedures can make it more straightforward for the Scientific

Committee to respond to requests for advice from the Council, as existing models and pre-defined catch rules would be used. The Scientific Committee would no longer have to guess at the management goals of the Council, as these would be implicit in the procedure used.

A single management procedure can fit a rather narrow range of possibilities in terms of management goals and acceptable levels of risk to the stock. As such they are most applicable to a single type of fishery where these factors are pre-defined. For example the RMP is specifically developed for commercial whaling on baleen whales, and a separate procedure is being developed for aboriginal subsistence whaling. The PBR catch rule is designed mainly for non-fishery, bycatch removals, where minimisation of risk to the stock is paramount. On the other hand, the balance between catch and risk to the stock can be adjustable, as for example with the tuning parameter of the RMP. Therefore management procedures like the RMP may be generalisable to management situations with somewhat different stock objectives than those for which it was originally designed

All management procedures developed to date are essentially single stock models that do not take into account other ecosystem relationships. In one sense this is not really relevant for procedures like the RMP, which use only information on stock trajectory and catch. It can be argued that the factors affecting stock trajectory, for example prey availability, are not relevant to the immediate goal of specifying catch levels that will maintain the stock above a specified level of depletion. In addition, such factors are generally not known and may not be susceptible to management intervention even if they are known. Nonetheless, the target level set for a stock may have implications for other fisheries (e.g. Schweder *et al.* 1998, 2000a), so multi-species and ecosystem considerations may play a larger role in future management procedures.

The development of any management procedure requires rigorously defined management objectives, including acceptable levels of depletion, levels of acceptable risk and time periods over which these factors are evaluated. NAMMCO has not yet defined these objectives for any species or fishery, and it is not clear whether they will do so. Therefore, the development and use of a management procedure by NAMMCO would be premature. Nevertheless, there may be specific cases where existing procedures, like the RMP or PBR, may be applicable or readily adaptable to a request for advice.

Another option for the Scientific Committee, applicable to all stocks and fisheries, would be to present advice that explicitly presents the risk of stock depletion at various levels of catch. An example of this is the advice developed by the Scientific Committee for West Greenland beluga. Such a presentation allows the management authority to choose the catch option that best suit their management objectives, even if they have not stated them explicitly. However even such a presentation of options requires the Committee to make decisions about the level of acceptable depletion and period of time to be evaluated.

In discussion the Scientific Committee agreed that the explicit statement of management goals was one of the most important considerations in providing high quality scientific advice on sustainable catch. Requests for advice on catch levels should contain a minimum of information about management goals and timelines so that they can be responded to effectively. It was agreed that a Correspondence Group should be established to provide guidance to the Council in the most effective formulation of requests for advice. Witting agreed to chair the correspondence group. The group will report to the Scientific Committee by correspondence before the next meeting of Council so that their recommendations can be approved by the Committee. These recommendations will then be presented to the Council at their meeting in March 2003.

The Committee considered that one of the main problems with the use of explicit management procedures such as the RMP was the lack of flexibility in adapting to different management goals and different types of fisheries. While part of the intention in developing such procedures was to reduce the workload on the committee providing advice, experience with the RMP had shown that this was not necessarily the end result. The Committee was also concerned that once an explicit management procedure is adopted at the political level, it can be difficult to change some of the parameters and assumptions of the procedure even if they are demonstrated to be false.

The Scientific Committee favoured an approach where advice on catch levels is presented in a form that shows the probability of achieving desired stock trajectory under different catch options, with a full evaluation of the uncertainty of the predictions, if sufficient data are available to support such an assessment. The advice provided for West Greenland beluga is one example of this approach. In conducting assessments, it is also advantageous to use more than one assessment model if available, as this increases confidence in the results.

17. ELECTION OF OFFICERS

Gísli A. Víkingsson was elected as chairman for an additional year, and Lars Walløe was elected as vice chairman.

18. ANY OTHER BUSINESS

International Convention on Migratory Species

Walløe brought to the attention of the Committee that the International Convention on Migratory Species (CMS), the Bonn Convention, was considering the listing of a number of species of whales as being threatened with extinction or having an unfavourable conservation status. Once listed, member countries will be obligated to take management actions that may preclude harvest in some circumstances. The main reason for the listing action would appear to be that some of these species are also listed in the IUCN "Red List".

The Scientific Committee expressed concern about this matter and noted that many Red List classifications were themselves outdated and based on questionable

information. It was considered that international organisations have a responsibility to be critical and conduct credible research when taking action that may affect the resource use activities of their members.

The Scientific Committee will therefore advise the NAMMCO Council and the member governments to initiate a scientific review and revision of the "Red List", so that new and more accurate status can be assigned to each of the North Atlantic marine mammals species.

Age determination center

The Scientific Committee had received an unsolicited proposal from Dr Christina Lockyer for the setting up of an international age determination centre for mammals to answer the needs of various baseline research studies connected with life history and population parameters required for management and conservation. The proposed centre would provide ageing services as well as training and calibration of ageing with other laboratories.

The Scientific Committee considered that such a centre would be useful to laboratories and institutions in member countries, where ageing activity is too sporadic to maintain dedicated trained personnel. It would also be useful for training of ageing technicians and to facilitate inter-laboratory comparisons. While the Scientific Committee is not in a position to offer financial support for the establishment of such a centre, it was agreed that its establishment would be a positive step and should be supported.

19. ACCEPTANCE OF REPORT

The Report was accepted on September 19, 2002. The Scientific Committee expressed their thanks for the use of Hvalfjörður facility and noted that the beautiful surroundings had enhanced the atmosphere of the meeting.

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Appendix 1: **LIST OF PARTICIPANTS**

Faroe Islands
Dorete Bloch
Geneviève Desportes
Bjarni Mikkelsen

Greenland
Aqqalu Rosing-Asvid
Lars Witting

Iceland
Þorvaldur Gunnlaugsson
Droplaug Ólafsdóttir
Gísli A. Víkingsson (Chairman)

Norway
Tore Haug
Lars Walløe

Ex-Officio Members
Grete Hovelsrud-Broda, NAMMCO
Daniel Pike, NAMMCO

Other
Charlotte Winsnes, NAMMCO

Appendix 2: **AGENDA**

1. Chairman's welcome and opening remarks
2. Adoption of Agenda
3. Appointment of Rapporteur
4. Review of available documents and reports
   - 4.1 National Progress Reports
   - 4.2 Working Group Reports
   - 4.3 Other reports and documents
5. Co-operation with other organisations
   - 5.1. IWC
   - 5.2 ICES
   - 5.3 Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga
6. Incorporation of the users knowledge in the deliberations of the Scientific Committee.
7. Update on Status of Marine Mammals in the North Atlantic
8. Role of marine mammals in the marine ecosystem
   - 8.1 WG on marine mammal - fisheries interactions
   - 8.2 Other matters
9. Marine mammal stocks -status and advice to the Council
   - 9.1. Harp seals
     - 9.1.1 Update on progress
     - 9.1.2 Future work
   - 9.2. Hooded seals
     - 9.2.1 Update on progress
     - 9.2.2 Future work
   - 9.3. Harbour porpoise
     - 9.3.1 Update on progress
     - 9.3.2 Future work
   - 9.4. Narwhal

Appendix 3

LIST OF DOCUMENTS

SC/10/1	List of Participants
SC/10/2	Provisional Annotated Agenda (Draft)
SC/10/3	List of Documents
SC/10/NPR-F	National Progress Report – Faroe Islands
SC/10/NPR-G	National Progress Report – Greenland
SC/10/NPR-I	National Progress Report – Iceland
SC/10/NPR-N	National Progress Report – Norway
SC/10/4	Observers Report: 54th Meeting of the IWC Scientific Committee, Shimonoseki, Japan
SC/10/5	NAMMCO Conference "User Knowledge and Scientific Knowledge in Management Decision Making"
SC/10/6	Status of Marine Mammals in the North Atlantic – Update
SC/10/7	Workshop Report: Modelling marine mammal - fishery interactions in the North Atlantic.
SC/10/8	Report of the NAMMCO Scientific Committee Working Group on Abundance Estimates.
SC/10/9	Status of the proposed NAMMCO Science Fund
SC/10/10	Revisions to the Rules of Procedure for the Nammco Scientific Committee
SC/10/11	Update on NAMMCO Scientific Publications
SC/10/12	NAMMCO Scientific Committee Budget 2002.
SC/10/14	Summary of requests by NAMMCO Council to the Scientific Committee, and responses by the Scientific Committee
SC/10/15	Provision of advice on sustainable catch to Council
SC/10/16	Haug, T. Nilssen, K.T., Corkeron, P. and Lindblom, L. Diets of harp and hooded seals in drift ice waters along the east coast of Greenland.
SC/10/17	Lockyer, C. Proposal for establishing an Age Determination Centre – start-up funding
SC/10/18	Report on the estimation of minke whale abundance around Iceland from the NASS 2001 and 1987 aerial surveys.
SC/10/19	Heide-Jørgensen, M.P. Prospects for future NAMMCO assessments of narwhals and belugas in Baffin Bay

Appendix 4

RULES OF PROCEDURE FOR THE NAMMCO SCIENTIFIC COMMITTEE

I. TERMS OF REFERENCE

1. The Scientific Committee shall provide scientific advice to the Council on such matters that are referred to it, and ensure that this advice is based on the best available scientific findings at any given time. This includes review and evaluation of data on stock identity, biological parameters, stock size, catch history and other information necessary for conducting an assessment of the species or stock in question and for providing advice on catch limits and conservation.
2. The Committee may make proposals to the Council concerning any scientific tasks to be included in its future work.

II. MEMBERSHIP

1. Each Contracting Party shall nominate up to three scientists as members of the Scientific Committee. The appointment is permanent or until the Contracting Party nominates new member(s) to the Committee. Each member of the Committee shall have one vote when procedural or organisational matters are being dealt with.
2. The Scientific Committee shall elect by majority vote from amongst its members a Chairman and a Vice-Chairman. The Chairman and Vice-Chairman shall serve for two years, after which they may be re-elected. The terms of office of the Chairman and Vice-Chairman shall begin at the conclusion of the NAMMCO Council meeting for the year in which they are elected.
3. If for any reason the Chairman is unable to complete his term of office, the Committee shall elect a new Chairman at its next regular meeting. If needed, the Chairman of the Council may call for postal elections of the Chairman and Vice-Chairman of the Scientific Committee.
4. The General Secretary and the Scientific Secretary of the NAMMCO Secretariat shall be *ex officio* non-voting members of the Scientific Committee.
5. The Scientific Committee may, on an *ad hoc* basis and subject to the approval of the Council, nominate experts to participate in meetings of the Committee as *ex officio* non-voting members. Any such nomination of experts must reach the Secretary of NAMMCO no later than 30 days before the start of the meeting in question.

III. OBSERVERS

1. Canada and the Russian Federation shall be invited to send one (1) observer each to annual meetings of the Scientific Committee.

2. Other organisations may be invited to send observers to annual meetings of the Scientific Committee, subject to the approval of the Committee and the Council.
3. Participation of observers in the deliberations of the Scientific Committee will be at the discretion of the Chairman

IV. ORGANISATION

1. The Scientific Committee is responsible for collecting and compiling the necessary information for providing scientific advice. While avoiding duplication of work being carried out elsewhere, the Committee decides where and how this information is to be obtained. If the Committee considers it necessary to consult information not available in the published literature or in the possession of any of the Parties, any co-operation in this field with external authorities shall be undertaken by the Scientific Committee Chairman through the Secretary of NAMMCO.
2. The Scientific Committee may establish designated Working Groups on clearly defined subjects related to the work needed to be carried out for dissemination of the required scientific advice.
3. The Scientific Committee decides the terms of reference of the Working Groups, their provisional agenda, membership, Chairmen and dates of meetings, and makes proposals to the Council on invitation of external experts or observers.
4. The Working Groups report their findings in writing to the Scientific Committee according to their terms of reference.
5. The Scientific Committee shall report its findings in writing to the Council within two weeks after concluding its deliberations . The contents of the report shall be considered strictly confidential prior to that. The Report of the Scientific Committee shall include an Executive Summary. The Chairman seeks to have all views expressed on substantive matters during the deliberations in the Committee made clear in its report and the wording approved by the Committee before the end of its meeting or by correspondence if agreed by the Committee. Approval of the report requires consensus among the Committee members.

V. MEETINGS

1. The Scientific Committee shall meet at least annually, at least 14 weeks prior to the regular meetings of the Council, unless otherwise decided by the Committee or the Council. Intersessional meetings may be held when judged necessary by the majority of the Scientific Committee and/or the Council so decides.
2. A provisional agenda for all Scientific Committee meetings shall be developed by the Chairman and distributed to the members of the Committee no later than 30 days prior to the meeting in question. Comments or suggestions for revision of the provisional agenda shall reach the Chairman no less than 10 days prior to that meeting.

3. The Chairman shall, in consultation with other members of the Committee and the Secretariat of NAMMCO, seek to ensure that key documentation of relevance to the provisional agenda is available at the start of each meeting. This may involve compilation of published information and invitation to members, Parties, Working Group Chairmen or external experts to submit and present scientific papers at the meetings. Any scientist may submit scientific paper(s) for consideration by the Committee and Working Groups, as appropriate.
4. Each Party having information on the biology of marine mammals relevant for NAMMCO management objectives, including research and statistical material on catches of relevant species or stocks, shall briefly report on such information at the relevant meetings of the Scientific Committee or its Working Groups.
5. The Scientific Committee, in consultation with the Secretariat of NAMMCO, shall make proposals for contract studies to be conducted on specific agenda items to be dealt with at meetings of the Scientific Committee or its Working Groups.
6. The Secretariat of NAMMCO may, with the concurrence of the Committee, set technical guidelines for the preparation, format and presentation of all meeting documents, including type and format of data on catches that each Party reports with respect to any relevant catch operation.
7. Titles of meeting documents outlined in V.3.-5. above shall, if possible, reach the Secretariat of NAMMCO no less than 10 days in advance of the meeting in question and be distributed to the members of the Committee/Working Group prior to the meeting. All documents registered before the end of the first day of the meeting shall be considered Primary Documents for consideration at the meeting.
8. English shall be the official language of the Scientific Committee and all primary documents shall be written in English. The Chairman can give exemptions from this general rule after consultation with other Committee members and the Secretary of NAMMCO.

VI. DATA AVAILABILITY

1. The Report of the Scientific Committee and the reports of the Committee's Working Groups shall be made available by the Secretariat to anyone that so wishes, according to guidelines set by the Scientific Committee and after they have been dealt with by the Council. Such guidelines are subject to approval by the Council and are included as Annex 1. The Scientific Committee shall aim to have all key scientific papers relevant to its work published in a recognised international scientific journal.
2. Unpublished scientific papers submitted to the Scientific Committee or its Working Groups shall be available only to the Scientific Committee and the relevant Working Group(s). Such papers will not be further distributed or cited without the express permission of the primary author.
3. The Secretariat of NAMMCO may, with the concurrence of the Scientific Committee and the Council, require that statistical material and computing

programs for use in evaluation of the status of stocks or for calculations of catch limits, such as detailed catch and abundance data, be submitted in advance to the Secretariat in an electronic data storage medium, for validation and preparation prior to the meeting. Submitted statistical material or other raw data shall only be released from the Secretariat subject to approval of the scientist or Party submitting the data.

VII. AMENDMENTS OF RULES

Proposals for amendment of these rules of procedure shall reach the Secretariat not less than 60 days prior to the Council meeting at which the matter is to be discussed. The Secretariat shall inform the Contracting Parties about these proposals not less than 30 days prior to that meeting.

Annex1

GUIDELINES FOR THE RELEASE OF DOCUMENTS BY THE SCIENTIFIC COMMITTEE

1. Documents for meetings of the Scientific Committee and subsidiary Working Groups shall be made available to Committee or Working Group members and observers in advance of the meeting if possible, or on the first day of the meeting.
2. Reports of subsidiary Working Groups shall be given to the Scientific Committee as soon as they are completed and accepted by the Working Group.
3. The Report of the Scientific Committee will not be distributed outside of the Scientific Committee until it has been dealt with by the Council.
4. Subject to (3.), the Report of the Scientific Committee will be distributed by the Secretariat to international government organisations, observer and other governments, non-government organisations, researchers and other interested parties according to a distribution list maintained at the Secretariat.
5. Subject to (3.), the Report of the Scientific Committee will be given to any organisation or individual on request. The Secretariat reserves the right to charge for printing and distribution.
6. Subject to (3.), a summary of the Report of the Scientific Committee will be published on the NAMMCO internet site.
7. Subject to (3.), the full Report of the Scientific Committee will be published on the NAMMCO internet site.
8. The full Report of the Scientific Committee, including the reports of subsidiary Working Groups, will be published in the NAMMCO Annual Report.

Unpublished scientific papers submitted to the Scientific Committee or its Working Groups shall be available only to the Scientific Committee and the relevant Working Group(s). Such papers will not be further distributed or cited without the express permission of the primary author.

ANNEX 1

NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON ABUNDANCE ESTIMATES

Kerteminde, 13-15 March, 2002

1. OPENING REMARKS

Chairman Nils Øien welcomed all participants to the meeting (see Section 5.5). He reviewed the terms of reference for the Working Group.

At its 1999 meeting, the NAMMCO Council recommended that the Scientific Committee continue its efforts to co-ordinate future sighting surveys and analyses of the results from such surveys in the North Atlantic. In response, the Scientific Committee convened a meeting of this Working Group in November 2000, for the dual purpose of continuing analyses from previous NASS surveys, and planning a NASS survey for 2001. The Working Group developed a survey plan which incorporated vessel surveys by the Faroe Islands, Iceland and Norway, and an aerial survey around coastal Iceland, as in previous NASS surveys. This plan was further developed and modified by correspondence among Working Group members and at an additional training/planning meeting held immediately before the survey. The NASS-2001 survey was conducted in June - July 2001.

The main purpose of the meeting was to review survey reports and abundance estimates from the survey, particularly for the target species minke and fin whales. Many of these estimates were only partially complete, so the Working Group was to recommend additional analyses to be conducted. A secondary objective was to evaluate the survey design and procedures used, and make recommendations for future surveys. Finally, the Working Group was asked to plan and schedule the publication of the results from NASS-2001, and those from previous surveys that had not already been published.

2. ADOPTION OF AGENDA

The Draft Agenda (Appendix 1) was adopted without changes.

3. APPOINTMENT OF RAPPORTEUR

Daniel Pike, Scientific Secretary of NAMMCO, was appointed as Rapporteur for the meeting.

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

The documents considered by the Working Group are listed in Appendix 2. Document SC/10/AE/4, Abundance of minke whales from NASS-2001 ship surveys, had not been completed in time for the meeting. An additional document describing the Faroese ship survey was accepted as SC/10/AE/15. In addition, working papers

from previous meetings of the Working Group, and other published documents, were also available as needed.

5. SURVEY REPORTS

Working papers describing the general methodology and results from the 2001 ship and aerial surveys were briefly reviewed by the Working Group. Target species of the surveys were minke and fin whales for the Faroes and Iceland, and minke whales for Norway. For the first time the Faroese and Icelandic vessels used identical methodology, a Buckland-Turnock (BT) mode using 2 independent observer platforms. This involves one platform (the "tracking" platform), searching further ahead to set up "trials" from which the detection function of the other platform (the "primary" platform) is estimated. It requires the primary platform to operate independently of the tracker platform, but not vice-versa. The Norwegian survey methodology was somewhat different as the Norwegian component of the NASS survey was also a part of their national 6-year rotational survey program.

After the survey had begun, permission to enter UK territorial waters was withdrawn for the Norwegian vessel and refused for the Faroese vessel. This necessitated a last-minute re-allocation of survey effort by the Norwegian vessel from the North Sea to the Norwegian Sea, and the abandonment of part of the planned Faroese survey block. The Working Group noted that because of this important areas were not surveyed, reducing the overall value of the survey results.

The final survey plan is shown in Fig. 1, and realised effort and sightings are shown in Fig. 2 - 12.

Faroese ship survey

The refusal of admittance to UK waters significantly reduced the size of the Faroese block. Consequently there was higher coverage in this reduced area. The primary north-south tracks were completed, and part of the secondary east-west tracks were completed as well. Weather was relatively good throughout the survey and most lines were completed in Beaufort sea state of 4 or less. A total of about 2,500 nautical miles was covered on effort, and 459 groups of cetaceans comprising twelve species and 1,798 individuals were sighted. The most common species were by rank pilot whales, sperm whales, bottlenose whales, white-sided dolphins, harbour porpoises, minke whales and fin whales.

Icelandic ship survey

Subsequent to the November 2000 Working Group meeting, it was decided in Iceland to share survey effort on an international redfish survey being conducted by Icelandic survey vessels participating in the survey. This necessitated a change in the survey area, block structure and effort allocation. The northern and eastern parts of the Icelandic area were still surveyed by a dedicated survey vessel.

Planned transects had to be adjusted because of prevailing weather and ice conditions, particularly in the northern and north-western areas covered by the dedicated vessel.

The primary target species of the survey were minke and fin whales but an emphasis was made to identify as many sightings to species as possible in particular to distinguish fin and blue whales. Cetaceans of 14 species were identified in the survey. These were in addition: sei, humpback, sperm, northern bottlenose, pilot, and killer whales, a beaked whale, white beaked, Atlantic white sided, likely bottlenose dolphins and harbour porpoises. The most common large whales were fin whales (890 animals in 556 sightings) and humpback whales (441 animals in 282 sightings).

Icelandic aerial survey

The survey design was identical to that used in 1995 and 1987, except that Blocks 5, 7 and 9 were extended eastward from 11° to 10° W. This was done to achieve better coverage of a major concentration of humpback whales in the area. A greater emphasis was placed on observer training in an effort to avoid some of the problems experienced in earlier surveys. Double platform effort was maintained throughout the survey with the cruise leader, and partially the pilot acting as secondary observers. Realised effort was greater than that achieved in 1987, but less than that achieved in 1995. At least partial coverage was achieved in every block. In all 537 primary sightings of 1,354 animals comprising at least 9 species were made, including 200 sightings of minke whales, 161 of humpback whales and 118 of dolphins.

Norwegian ship survey

The last-minute shift from the North Sea to the Norwegian Sea resulted in problems in co-ordinating the activities of the Norwegian survey vessel. Due to miscommunication very little of the planned effort was realised. Poor weather affected the second half of the survey. As a result this survey block was not covered. The vessel did however collect surfacing data for minke whales that will be of use in future surveys.

6. MINKE WHALES

i. Ship survey

NASS-2001

No abundance estimate was available for minke whales from the Faroese and Icelandic ship surveys. However the Working Group noted that the coverage and distribution of sightings in the Icelandic survey area may necessitate some non-standard analyses. Because of weather and ice related revisions to the survey plan in the northern and north-western blocks, the coverage probabilities were substantially higher in some parts of strata than in others. Sightings of minke whales were highly clustered close to the northern and western edges of the western and north-western blocks, presumably in association with the pack ice edge. This corresponds to an area of high coverage probability. Very few sightings of minke whales were made in the western block, which was mostly surveyed in unfavourable conditions for detecting minke whales (high Beaufort sea state and fog). For these reasons, the Working Group recommended that a spatial analysis be pursued for minke whales and possibly other highly clustered species such as humpback whales. In such an analysis the random placement of transect lines in relation to geographical features is unnecessary. Such an analysis can produce an estimate of greater precision than a line transect analysis,

and can provide a better understanding of the underlying distributional patterns of the animals. As a simpler alternative to a spatial analysis, some post-stratification of the original blocks could be pursued.

NASS-95

In 1997 the NAMMCO Scientific Committee Working Group on Abundance Estimates derived an estimate of the abundance of minke whales in the Icelandic survey area of NASS-95 (NAMMCO 1998a). This estimate had 2 components: one from coastal waters covered by the aerial survey, and the other from offshore waters covered by the shipboard survey. However the shipboard estimate was apparently calculated at the meeting and was never properly documented. SC/10/AE/6 presented a recalculation of this estimate for archival purposes.

The analysis used standard line transect methods. No double platform data was available to correct for whales missed by the observers. The estimate was calculated using both the original block structure and a post-stratification of block 9 between Iceland and E Greenland to a smaller block that included all the sightings. This post-stratification had been used in the original reported estimate. The total estimates for the survey area and for the survey area outside the aerial survey block were almost the same as those reported in NAMMCO (1998a), irrespective of post-stratification, although there were some minor differences in the individual block estimates and variances. These estimates are negatively biased by both perception and availability biases.

In discussion the Working Group considered that the post-stratification of block 9 was acceptable because it was not based on observed minke whale distribution, but was done in an effort to achieve equal coverage probability in the area close to the pack ice edge. This area is more sheltered that the rest of the block and less effort was discarded due to high Beaufort conditions. The derived estimate will be useful for comparison with similarly calculated estimates from earlier surveys.

ii. Aerial survey

SC/10/AE/5 described an estimate of minke whales from the aerial cue counting survey around Iceland. The survey, conducted in June-July, was the fourth large-scale aerial survey covering Icelandic coastal waters since 1986. Stratified cue counting methods were used to calculate a preliminary estimate of the abundance of minke whales in the survey area. Because of differences in the viewing patterns and sighting efficiencies of the primary observers, 2 estimates were calculated, one using only the better observer, the other using data from both observers. The best estimate of minke whale abundance in the survey area was derived using only the data of the best observer and a cueing rate of 53 cues per hour (no variance estimate), 40,115 whales (95% CI 24,660 to 65,257) for the entire area. This was about 1.4 times the estimate using both observers, with a slightly higher variance. Double platform effort was maintained throughout the survey, and it appears that the proportion of cues seen close to the survey platform approached 1 for this observer. This estimate may be positively biased by failure to account for error in measuring radial distances. However it appears that distances were measured relatively precisely (CV 8%) so this bias is

probably slight. The estimate is higher than that obtained in 1987 and lower than that from 1995. However the lack of data on distance estimation error in 1995 preclude comparison of the 1995 estimate with other years.

The Working Group agreed that the estimate using data from the best observer only was less biased than the estimate using both observers. There is still a need to account for bias due to random error in radial distance measurement, but it was considered that the bias due to this factor is unlikely to be large, given that the observed measurements have an estimated CV of only 8%. A more important factor is likely the cue rate used. Data collected from tagging of minke whales off Norway indicates that the cueing rate there is somewhat lower than the cueing rate of 53 cues per hour used here. This would increase the estimate by proportion. In addition, variance in cueing rate should be incorporated into the estimate.

The Working Group therefore concluded that completion of this estimate will require:

i. accounting for bias due to error in measuring radial distance, and;
ii. use of the best available cueing rate for minke whales during daylight hours, and incorporation of variance in cueing rate in the estimate, and;
iii. using double platform data to correct for perception bias. This may involve analysing the data with respect to where effort appears most concentrated.

It was anticipated that these tasks could be completed within 6 months.

The Working Group agreed that the 1987 and 2001 data should be analysed using consistent methodology that takes account of distance estimation errors.

iii. Combined estimates

As the ship survey estimate had not been completed, no combined estimate could be derived. The Working Group recommended that this be done in a timely fashion.

iv. Trends in abundance

SC/10/AE/7 presented an analysis of trends in distribution and abundance of minke whales from aerial surveys conducted in the coastal waters of Iceland in 1986, 1987, 1995 and 2001. The 1986 survey was conducted as a line transect survey, while the later surveys were conducted as cue counting surveys. The distribution of minke whales was very stable from year to year, with highest densities in the SW, N and SE waters of Iceland. Line transect density was used as an index of relative abundance, and all datasets were treated in an identical manner so that any trend signal would not be masked by analytical differences. Relative abundance showed a significant increase in the area to the N of Iceland, and moderate but non-significant increases in the high-density area in SW Iceland (Faxaflói), NW Iceland and in the survey area as a whole, over the period. The apparent increases in the N and NW of Iceland may be partially due to the cessation of minke whaling, which was concentrated in these areas up to 1985.

In discussion the Working Group noted that an analysis of simple encounter rate would likely give similar results (SC/10/AE/14). The Working Group concluded that the abundance of minke whales around Iceland has been stable or shown a moderate

increase over the period. The apparent increase in relative abundance in block 4 is consistent with population growth after cessation of catching, however other factors, such as immigration from other areas, may also be involved. There are also indications of better feeding conditions off northern Iceland in 2001 than in previous surveys.

7. FIN WHALES

i. 2001 ship survey

SC/10/AE/8 described the abundance estimate for fin whales from the Icelandic and Faroese ship surveys. The distribution of sightings of fin whales (see Fig. 3) was more even than in earlier surveys, particularly in the blocks west of Iceland, where the distribution in previous surveys was more concentrated around the continental slopes. Double platform data collected indicated that the proportion of whales seen by the primary observers close to the trackline was close to 1 for this species, and that a correction for whales missed would not increase the estimate substantially while increasing the variance. Estimates by block and for the total area are given in Table 1. The estimate for the total area of 25,352 is higher and has a lower CV than estimates from equivalent areas from past NASS surveys. While some of this increase may be related to increases in survey efficiency, this factor alone likely cannot explain the observed increase since 1987. Stock increase, immigration from other areas, and/or variation in distribution between years may also be involved.

The Working Group concluded that this estimate is likely to be only slightly negatively biased by perception and availability biases, and accepted that correcting for perception bias was not likely to be worthwhile. The four NASS ship surveys carried out since 1987 provide an excellent time series of abundance for this species. It was therefore recommended that a more complete analysis of changes in abundance over all the NASS surveys be conducted. This may require some re-analysis of past survey data as the coverage has changed between surveys.

The Working Group noted that sharing of survey platforms with the redfish survey had apparently been successful. International redfish surveys will be carried out over similar areas on a 3-year rotation, and cover a larger area to the south and west of the NASS-2001 survey area. The Working Group recommended that the possibility of extending the cetacean survey by sharing platforms with the other participating vessels in the redfish survey be further investigated.

Block	Area (nm)	*n*	*L* (nm)	*N*	CV (%)	95% CI	
Icel.SW	190,577	31	1,169	2,723	27.87	1,480	-5,009
Icel.W	154,692	271	2,424	10,800	15.20	7,862	-14,836
Icel.NW	28,154	144	616	5,513	38.81	2,274	-13,370
Icel.N	31,781	38	556	1,522	53.13	449	-5,155
Jan Mayen	145,847	47	1,791	2,719	38.13	1,196	-6,180
Faroe Isl.	117,500	62	2,457	2,074	27.39	1,139	-3,777
Combined	668,551	593	9,013	25,352	12.71	19,576	-32,831

Table 1. Abundance of fin whales in Icelandic and Faroese ship survey blocks from NASS-2001. *n* - number of fin whale groups sighted; *L* - survey effort; *N* - abundance.

8. OTHER SPECIES

i. Humpback whale

SC/10/AE/9 reported a line transect estimate for humpback whales from the 2001 Icelandic aerial survey. Sightings of humpback whales were highly concentrated off north-eastern Iceland and to a lesser extent off south-western and northern Iceland. A relatively high proportion of sightings close to the trackline by the secondary observers were duplicated by the primary observers, indicating that perception bias is low but not absent for this species. The total number of humpback whales in the search area was estimated to be 3,057 (95% CI 1,727 - 5,410), with NE Iceland accounting for over half of this number. However this estimate has a negative bias because of perception bias and, probably more importantly, animals missed because they were diving when the plane passed. The estimate from this survey is substantially (but not significantly) lower than that produced from the NASS-95 ship survey (Pike *et al.* MS 2001), however this may be due to the above mentioned biases and the fact that the ship survey covered a larger area.

Sightings from the NASS-2001 ship survey were also highly clustered around NE and W Iceland within the aerial survey block, but substantial numbers were also seen in areas farther offshore. More sightings were made in the Faroese block than in previous surveys. No estimate has been derived from these sightings as yet.

In discussion the Working Group noted that the contagious distribution of humpback whales seen in both the aerial and ship surveys may make spatial modelling a suitable analytical approach. It is likely that a spatial model would provide a more precise estimate and might enable some ecological interpretation of the observed distribution. The overlap between the shipboard and aerial surveys may also provide a means of correcting the aerial survey for availability bias, using the ratio of observed shipboard/aerial survey density in the overlap area. However such a correction factor is likely to have a high variance. Another approach might be to use diving data from other areas to correct for availability bias in the aerial survey.

SC/10/AE/14 analysed trend in the relative abundance of humpback whales over the course of the 4 Icelandic aerial surveys carried out since 1986. Encounter rate increased by an average of 11.4% (SE 2.1%) per year over the period in the survey area. Encounter rates for other species did not change much over the period, so it seems unlikely that the increase for humpback whales can be attributed to changes in survey efficiency. This rate of increase is in accordance with that of 11.6% over the period 1970 - 1988 in recorded sightings humpback whales by whalers operating west of Iceland reported Sigurjónsson and Gunnlaugsson (1990).

The Working Group noted that humpback whale sightings have also increased over the course of the NASS ship surveys conducted since 1987, and that much of this increase appeared to have occurred off E Iceland. It was considered useful to break

down the trend in the aerial surveys by E and W Iceland to see if the rates of increase differed. It is unlikely that a shift in distribution from offshore to inshore areas can account for this trend as the ship surveys indicate no such shift. Indeed, more offshore sightings of humpbacks were made in 2001 than in earlier surveys.

There has been almost no catch of humpback whales around Iceland since the first stage of Icelandic whaling came to an end in 1915 (Sigurjónsson and Gunnlaugsson 1990). Therefore, stock recovery is one plausible explanation for the trend, however the observed rate is on the edge of biological plausibility. Immigration from other areas may also be playing a role. The Yonah study (Palsbøll *et al*. 2001) has shown that there are at least 2 breeding populations of humpbacks in the North Atlantic, and that the whales around Iceland and Norway are a mixture of the 2 groups. It is possible that the stocks are growing at different rates, accounting for the apparent recent high growth rate around Eastern Iceland.

There has been very little sampling of humpback whales from E Iceland. Víkingsson noted that genetic and photographic sampling was planned for summer 2002, and would be continued if successful.

In summary the Working Group recommended the following with regard to humpback whales:

1. apply spatial modelling techniques to the 2001 aerial and shipboard surveys, and possibly to earlier surveys as well if this proves useful;
2. correct the aerial survey for perception bias using the double platform data;
3. attempt to correct the aerial survey for availability bias using the ratio of observed densities from the shipboard and aerial surveys in areas of overlap, or using diving data from the literature;
4. estimate trends separately in E and W Iceland.

ii. *Lagenorhynchus* dolphins

SC/10/AE/9 reported a line transect estimate for dolphins from the 2001 Icelandic aerial survey. Species identification was uncertain but 96% of the sightings were identified as white-beaked dolphins, with the rest being of unknown species identity. The high proportion of white-beaked dolphins is consistent earlier surveys and other information from the area. The distribution of dolphins was consistent with earlier surveys, with animals being concentrated in N central, SW and SE Iceland, however dolphins were found almost everywhere in the survey area. Group size estimation was somewhat uncertain but there was no apparent bias in group size estimation with perpendicular distance. The total number of dolphins in the search area was estimated to be 20,444 (95% CI 12,714 - 32,874). This estimate is biased downwards both by perception and availability biases. There are duplicate data that can be used to correct for perception bias, but this has not been done yet.

The Working Group recommended that further analyses that incorporate the duplicate data be completed. It was also recommended that the other aerial surveys be analysed in a similar manner to look for temporal trends.

There were large numbers of dolphin sightings in both the Faroese and Icelandic ship surveys. Virtually all sightings in the Faroese block were confirmed as white-sided dolphins. Some of these sightings were in an area in which *Lagenorhynchus* were also seen on the aerial survey. This should be investigated further. Most sightings from the Icelandic vessels were of white-beaked dolphins, but many sightings were not identified to species and it was considered that species identification was uncertain even for those that were identified. Tracking of dolphin groups by the secondary observers was not very successful in either the Faroese or Icelandic surveys, so there is insufficient information to correct for availability bias or responsive movement.

The Working Group reiterated its conclusions from 2000, that while an analysis of the shipboard dolphin data from this and earlier surveys is feasible, the problems of uncertain species identification, uncertain group size estimation, and possible responsive movement of these species would present significant problems for abundance estimation. As a first step, the Icelandic members agreed to inspect the data for these species to determine if further analyses are likely to be useful. If so, an analysis that assigned species identification probability using relevant explanatory variables should be considered.

iii. Pilot whales

A total of 55 sightings of 622 pilot whales was made in the Faroese block, more than in 1995. Sightings were concentrated in the western part of the survey block. The 32 sightings of 563 animals made by the Icelandic vessels were concentrated in the W and SW blocks. Unlike in the 1995 survey when pilot whales were a target species, no closing experiments were conducted to calibrate group size estimation.

The Working Group considered that, given the relatively high number of pilot whale sightings in the 2001 survey, and abundance estimation was worthwhile and should be conducted. Pike agreed to carry out the analysis. It was also noted that a recent successful application of satellite tags in the Faroe Islands will provide data with which to correct for availability bias for this species.

iv. Sperm whales

SC/10/AE/13 presented a calculation of sperm whale abundance from the 2001 Icelandic and Faroese shipboard surveys. For the first time data was collected in such a way that a cue count, using terminal dives as a cue, was feasible. The vessel to stopped or slowed down if it was heading to within 0.5 nm of a sperm whale to avoid triggering responsive cues, and the position of the cue relative to where the vessel would have been had it continued was used in the analysis. In addition to the cue count, which included only those animals that displayed a cue, a line transect estimate that included those animals that were visible on the surface as the vessel passed abeam was calculated. It was assumed that sperm whales cued twice per hour, and line transect estimate was corrected by assuming that sperm whales spent 20% of the time visible at the surface. For the Icelandic area, the weighted average of the two estimates was 9,477 (CV 0.406). A cue count estimate was not possible for the Faroese area because the positions of terminal dives were not recorded consistently. The ratio between the combined estimate for the Icelandic area, and a line transect estimate that

included all sightings (1.41), was used to correct the Faroese line transect estimate to 1,708 whales. The combined estimate for the entire area was 11,185 (CV 0.34). Data from past Icelandic harvests has shown that only male sperm whales are found in these waters.

In discussion the Working Group agreed that the methodology used was theoretically and practically valid. The cue rate and proportion of time spent on the surface used to calculate the estimate are of course crucial. While no data has been collected from this area, data collected from other areas could be applied to provide a better estimate of these parameters. Radio tagging studies in North Atlantic waters will however be required to provide more reliable estimates.

v. Bottlenose whales

More bottlenose whales were sighted in both the Icelandic and Faroese surveys than in previous surveys. Sightings of bottlenose whales were highly concentrated in the northern Icelandic block, but were well distributed throughout the Faroese block. As NAMMCO has used a line transect estimate from previous NASS surveys in an assessment of this species, it was considered worthwhile to proceed with a line transect estimate for this species, while recognising that it will have a substantial negative bias due to availability bias with this deep-diving species. In this regard the availability of dive data from Canadian waters was noted. Pike agreed to carry out the analytical work.

vi. Killer whales

There were 36 sightings of killer whales in the Icelandic shipboard survey, and 8 in the Faroese block. Most Icelandic sightings were concentrated on one leg in the northern block. It was noted that the animals there appeared to be travelling with the vessel, which may have led to multiple sightings of the same animals. The Working Group considered that an abundance estimate derived from these sightings was unlikely to be of use. However the distribution should be compared with that seen in earlier surveys.

vii. Blue whales

The Icelandic ship survey produced 29 sightings of blue whales, while 9 sightings were made in the aerial survey. While this is likely too few to derive a meaningful abundance estimate, it might be useful to compare encounter rate between surveys to determine if there is any evidence of a trend in relative abundance. However it was noted that such a trend might be confounded by between-survey differences in the effort dedicated to differentiating blue and fin whales. More effort was made to discriminate the species in 2001 than in earlier surveys.

9. EVALUATION OF SURVEY METHODOLOGY

i. Ship surveys

Working papers SC/10/AE/10 and 11 provided evaluations the platforms, equipment, training and methodologies used on the Icelandic and Faroese ship surveys. A major problem with the set-up on the Faroese vessel was that the tracker platform was lower

than the primary platform. Problems were also experienced with vibration on the tracker platform, making it difficult and uncomfortable to use the binoculars. The primary observers were instructed to search for both the primary species, minke and fin whales, which required them to search at greater distances from the platform than they would have if only minke whales had been targeted. BT design requires the tracker to search substantially further than the primary observers. This requirement was compromised on both the Faroese and Icelandic vessels. Few trackings of minke whales were made on the Icelandic vessels, probably because weather conditions prevented the trackers from seeing small whales at large distances, and possibly also because the observers tended to focus their search on the target fin whale. The application of the BT method was therefore not successful in terms of correcting for responsive movement and availability bias, although the duplicate data will still be useful in correcting for perception bias, and was felt to be useful in keeping observers alert.

Other more minor problems with the data forms and procedures are summarised in Appendix 3.

In discussion the Working Group considered that the application of the BT methodology was problematic in a combined survey for large and small whales, which did not restrict primary search effort to be substantially closer to the vessel than tracker search effort On these surveys, the BT method was compromised, and few trackings were made. Nevertheless the methodology might have been effective on the Faroese vessel had the tracking platform been higher than the primary platform, and if the problems with vibration had been less severe. It was also noted that tracking small whales at great distances requires experienced and motivated observers, so it is best to ensure that those observers best able to track are used on the tracking platform.

If the BT method was applied as intended, with the primary platform searching close to the platform and the tracker platform searching farther away, it is still likely that sufficient sightings of large whales would have been made.

Another possibility would be to use symmetric platforms, with all observers tracking whales and recording cues and tracking whales, as in the Norwegian minke whale surveys. Duplicate matching would be done after the survey rather than in the field. Initial sightings could be classified by distance to derive corrections for responsive movement and availability bias using the method of Palka and Hammond (2001). Such a methodology would benefit from automated timing of cues, as is done in the Norwegian surveys.. The effort put into tracking might also reduce the total number of sightings, but this might not be problematic as the effort applied is increased by fully utilising the data from both platforms.

The Working Group concluded that the combination of multi-species surveys and BT methodology as implemented in this survey was problematic. However it was emphasised that the double platform methodology in general was successful and will prove useful particularly in refining the estimates for minke whales and other smaller species. Further effort should be devoted to the automation of data recording and entry

so that observers can be better monitored by the cruise leader in the field. Finally, special attention must be paid to the design of platforms to reduce vibration, improve visibility and increase observer comfort.

There were problems in conducting distance experiments in these surveys and the Working Group reiterated its previous recommendations that such experiments be conducted during and after the survey.

ii. Aerial surveys

SC/10/AE/12 presented an evaluation of the methodology used in the Icelandic aerial survey, including considerations of survey platform, equipment, personnel, design and strategy, and procedures. A summary of the recommendations for future surveys is contained in Appendix 4.

A more fundamental consideration was whether cue counting from an airplane was the best approach to estimate minke whale abundance in Icelandic nearshore waters. The methodology is very demanding of observers, sensitive to distance estimation error and differences in sighting patterns between observers, although these factors can be accounted for in the analysis.. There have been problems with the conduct (1995, 2001) and analysis of data (all years) from the surveys that make comparisons of absolute abundance between surveys difficult.

In discussion the Working Group noted that cue counting from an airplane should be an effective methodology for minke whales. Correcting line transect estimates for availability bias is more difficult than for doing so for cue counting. The Working Group concluded that with the practical recommendations for improvements in equipment and procedures contained in Appendix 5, cue counting was still the best available methodology for minke whale surveys in this area. Of particular importance will be effective training of observers, and further automation and simplification of the process of data collection, entry and display. It is very important that the cruise leader have the capacity to monitor the performance of observers while the survey is in progress, so that problems can be corrected.

The Working Group agreed that the possibility of using an aerial digital photographic survey should be considered. This technique will be tested in Iceland in the coming year.

10. PUBLICATION OF SURVEY RESULTS

The Scientific Committee had directed the Working Group to devise a plan for the publication of results from NASS-2001 and earlier surveys. It was noted in this regard that none of the results from NASS-95 from the Icelandic and Faroese areas had yet been published. It had been originally planned to publish these results in a volume of NAMMCO Scientific Publications, but that plan had been abandoned.

It was agreed that a special volume on the NASS surveys in general would be of great interest to many researchers. Four NASS surveys have been conducted, over a long

enough time frame that temporal trends in distribution and abundance may be detectable. The volume therefore should not merely report abundance estimates from the later surveys, but should synthesise results from all the NASS surveys to elucidate temporal and spatial patterns. It was considered that the volume could best be organised by species, with contributors using information from all the NASS surveys regardless of national affiliation.

Nils Øien and Daniel Pike agreed to take responsibility for organising and editing the volume, to be published as a future issue of NAMMCO Scientific Publications.

11. OTHER BUSINESS

The Working Group will likely need to meet again in winter 2003, once various identified analyses have been completed.

The Working Group expressed their sincere appreciation for the hospitality they had enjoyed at the Fjord and Bælt Centre, and thanked Genevieve Desportes and the Director of the Centre, Heinrich Lehman Andersen, for hosting the meeting.

12. ADOPTION OF REPORT

The Report was adopted on March 15, 2002.

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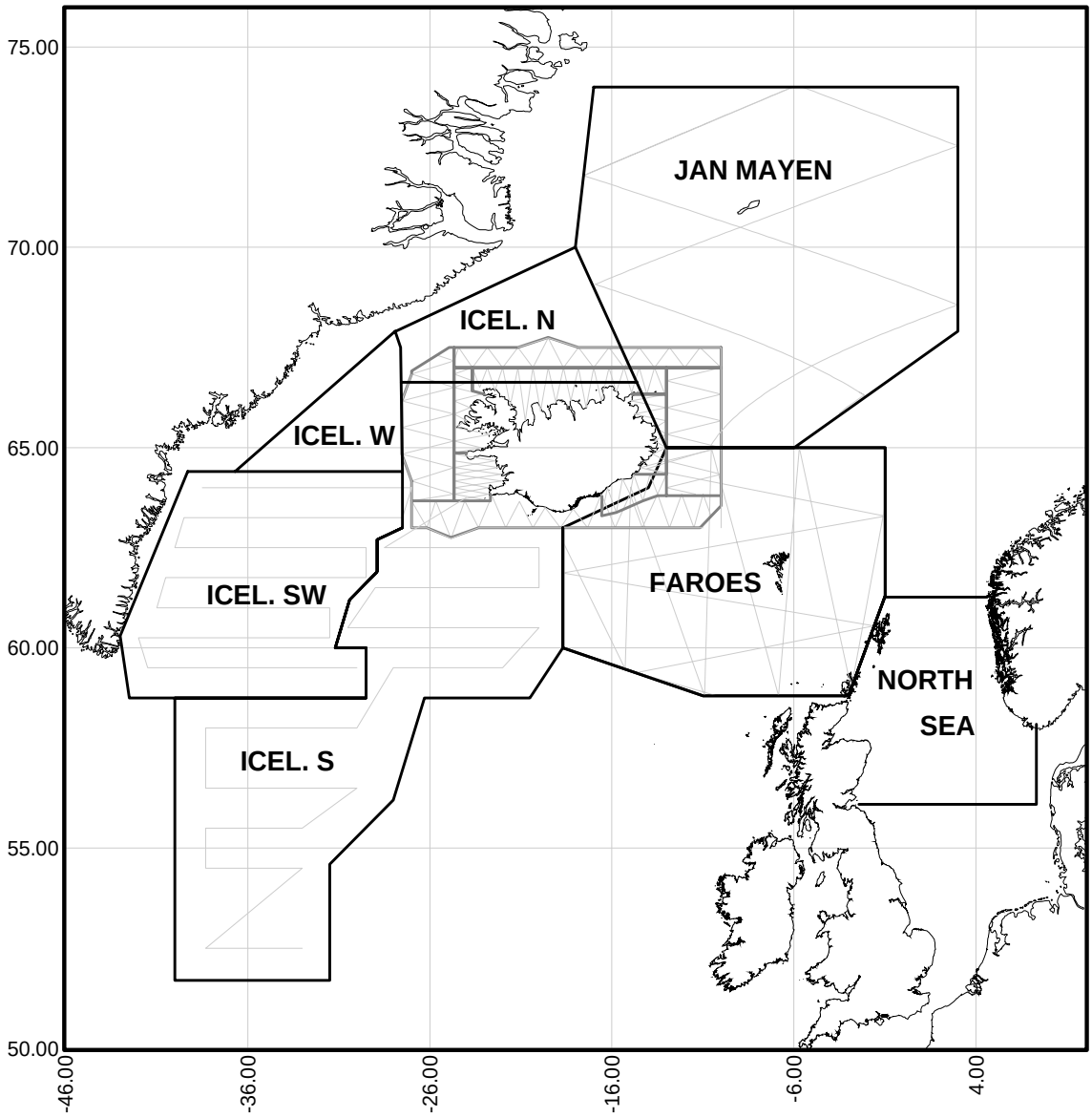

Fig. 1. Planned survey blocks and tracklines for NASS-2001. The North Sea block was not surveyed.

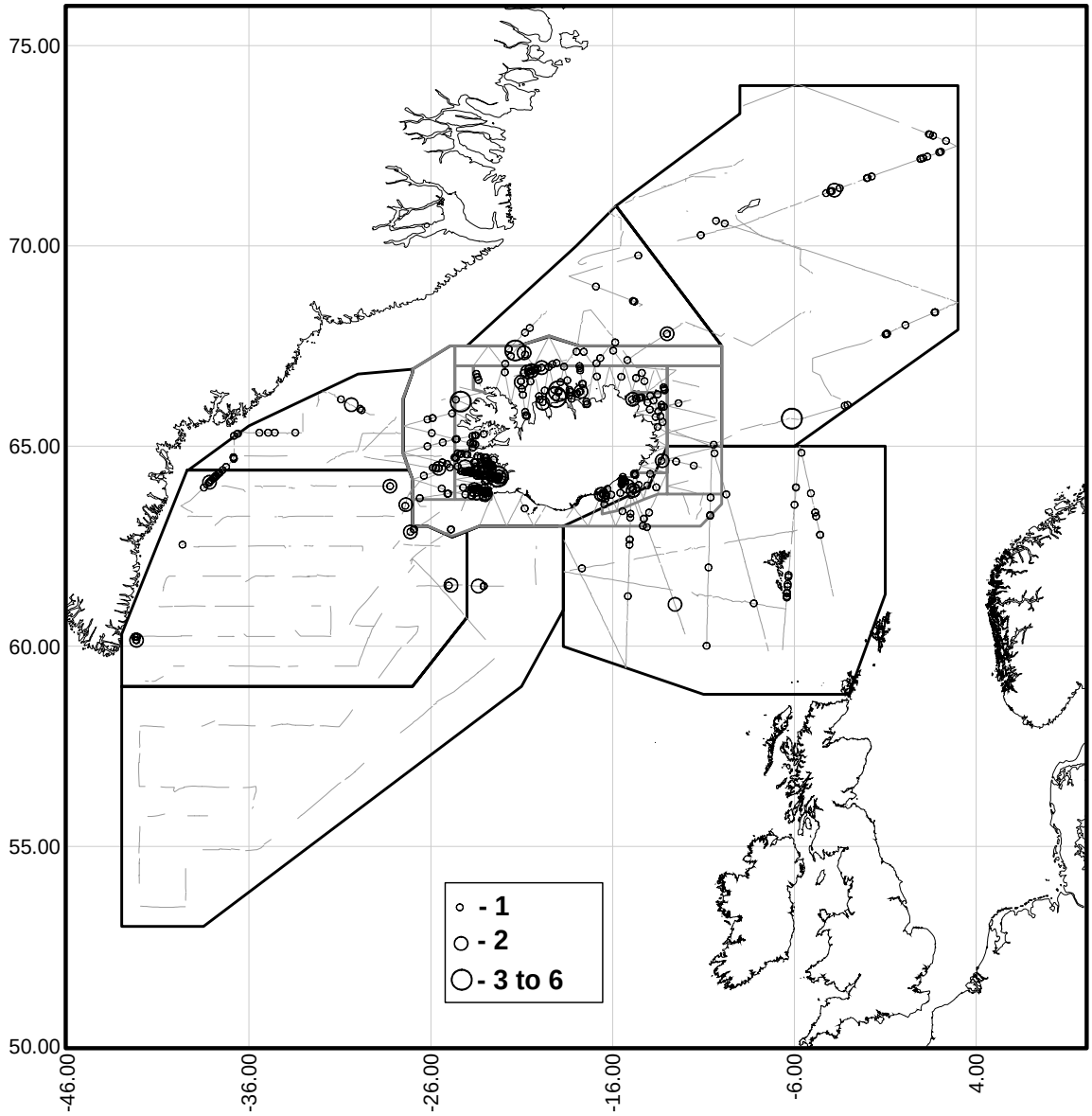

Fig. 2. Distribution of sightings of minke whales from NASS-2001.

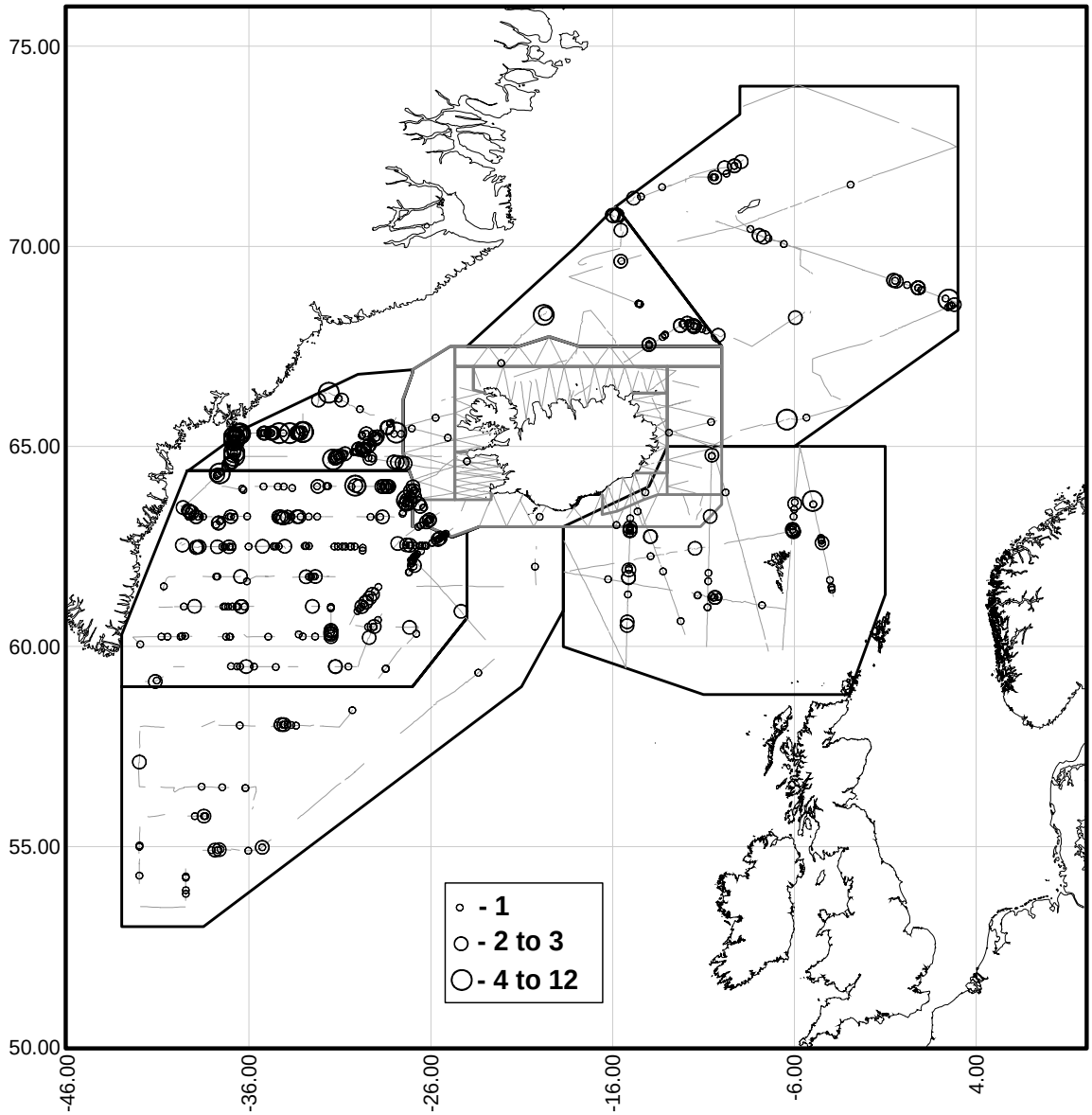

Fig. 3. Distribution of sightings of fin whales from NASS-2001.

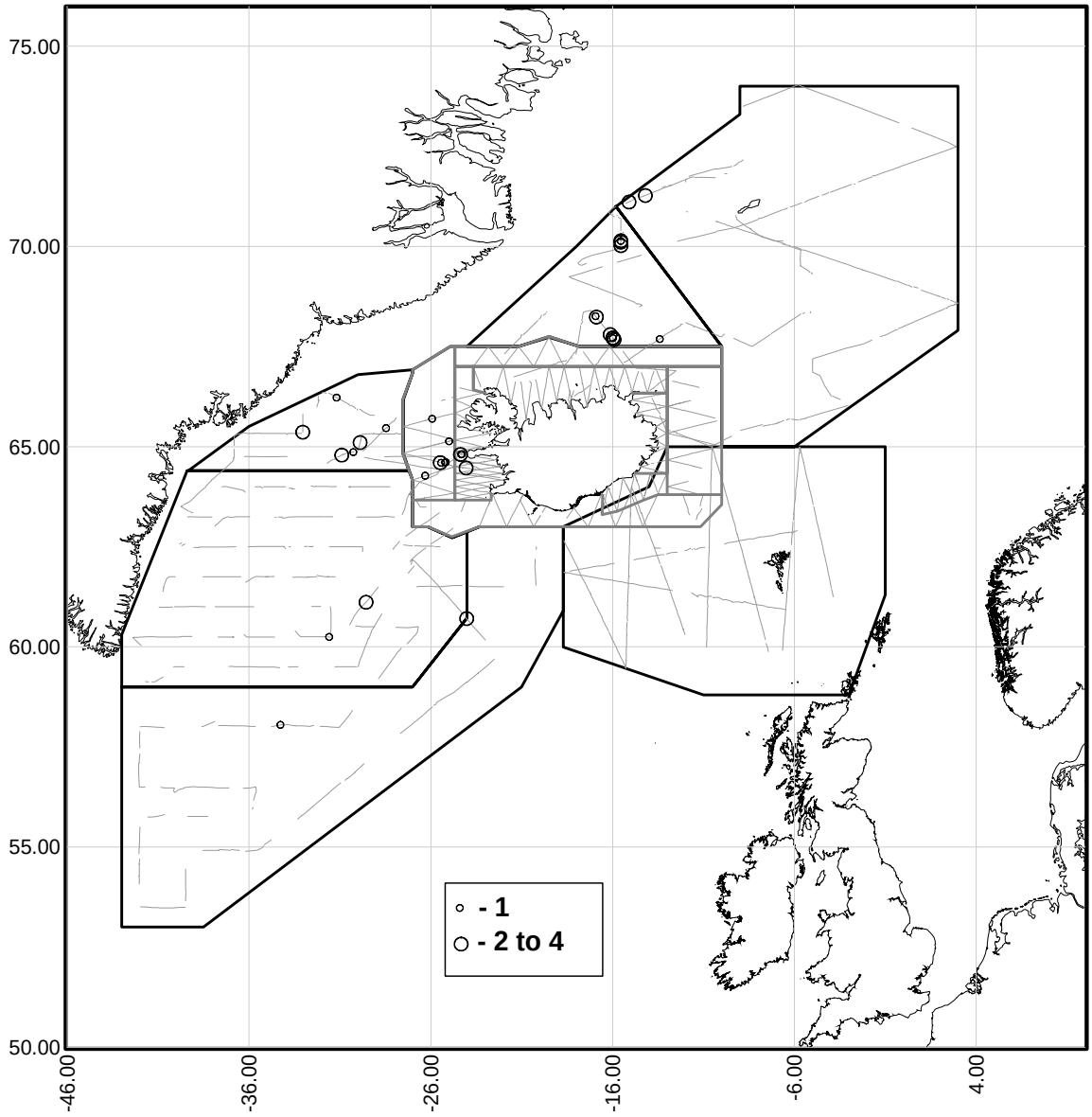

Fig. 4. Distribution of sightings of blue whales from NASS-2001.

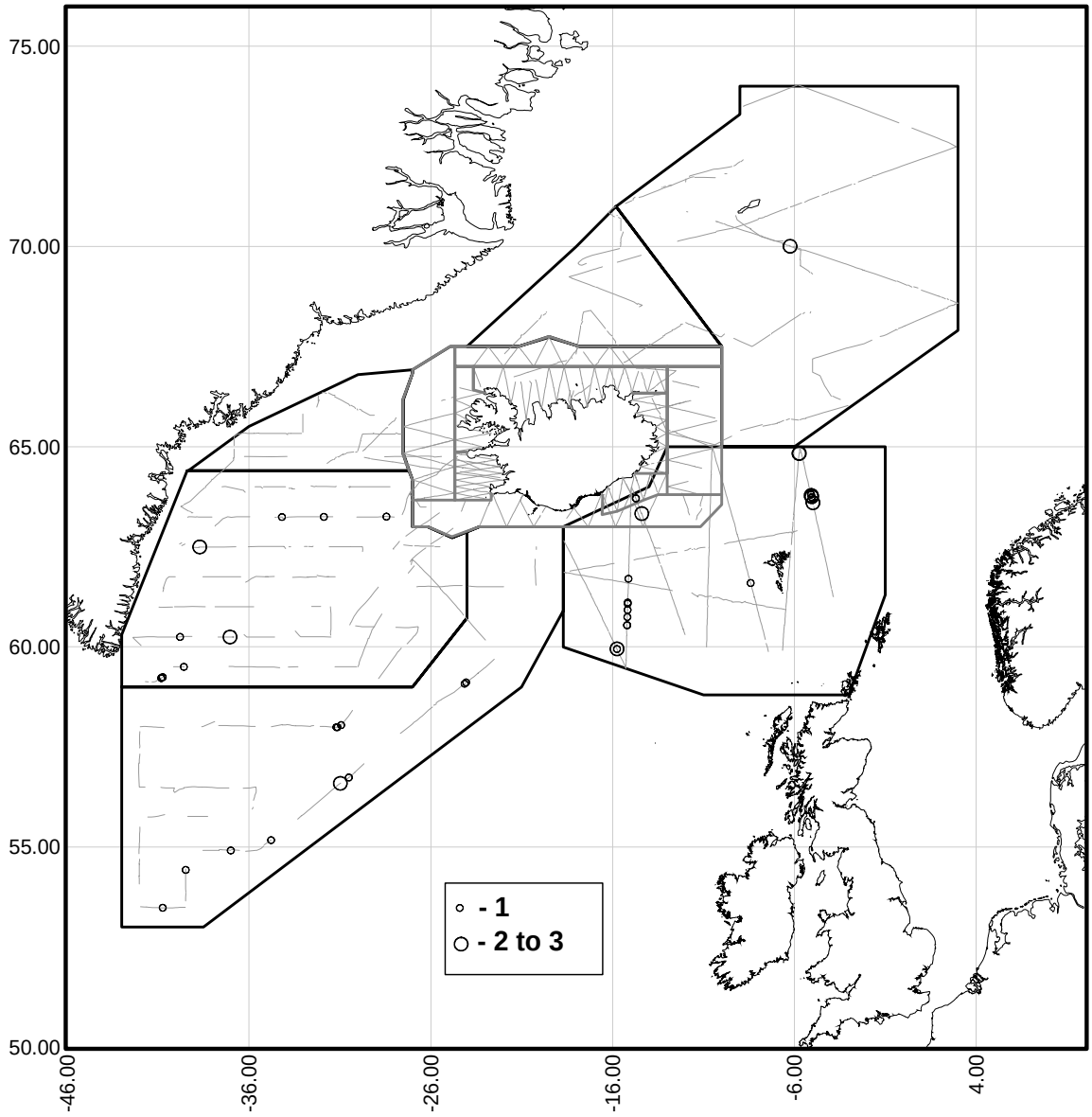

Fig. 5. Distribution of sightings of sei whales from NASS-2001.

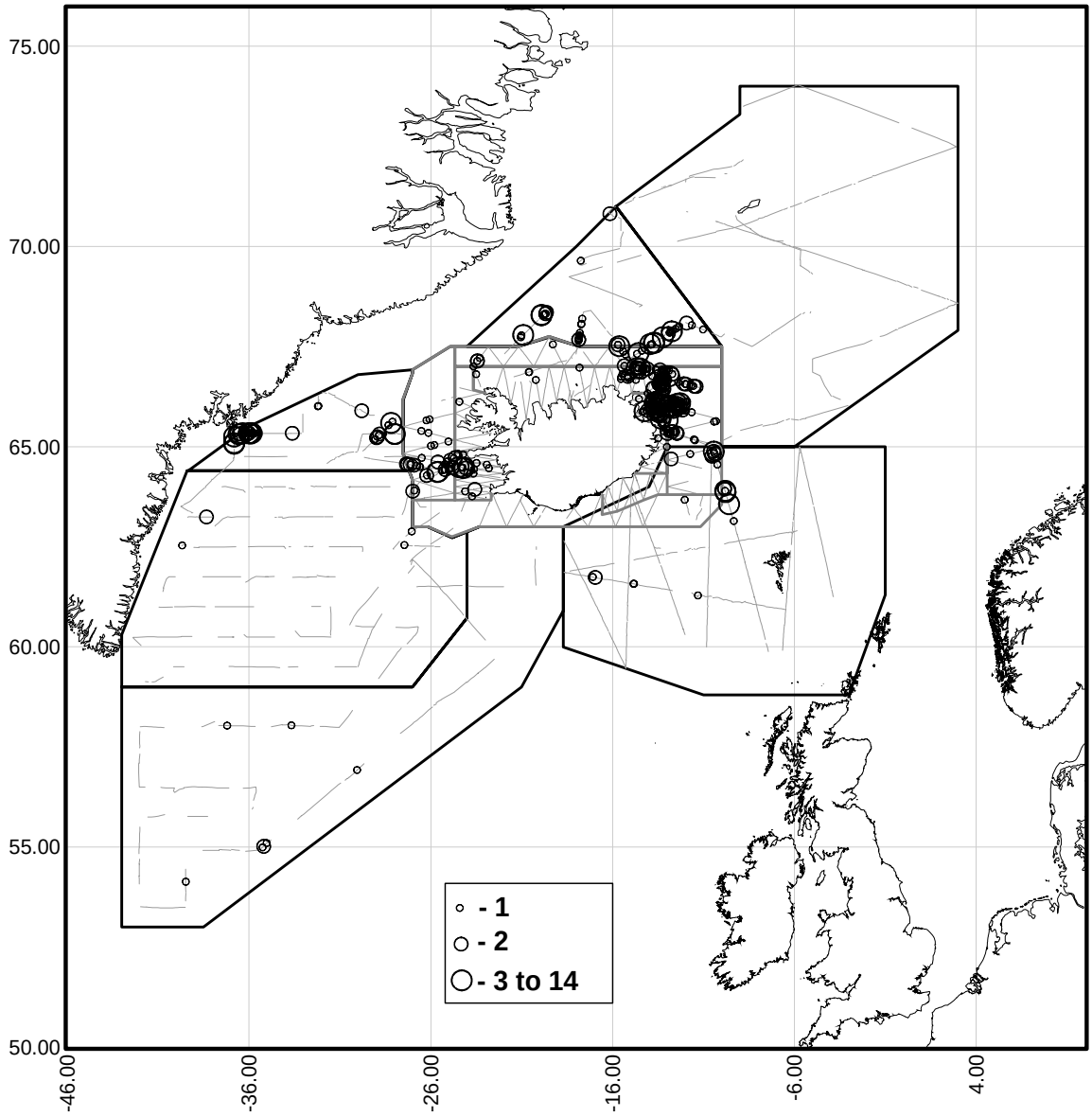

Fig. 6. Distribution of sightings of humpback whales from NASS-2001.

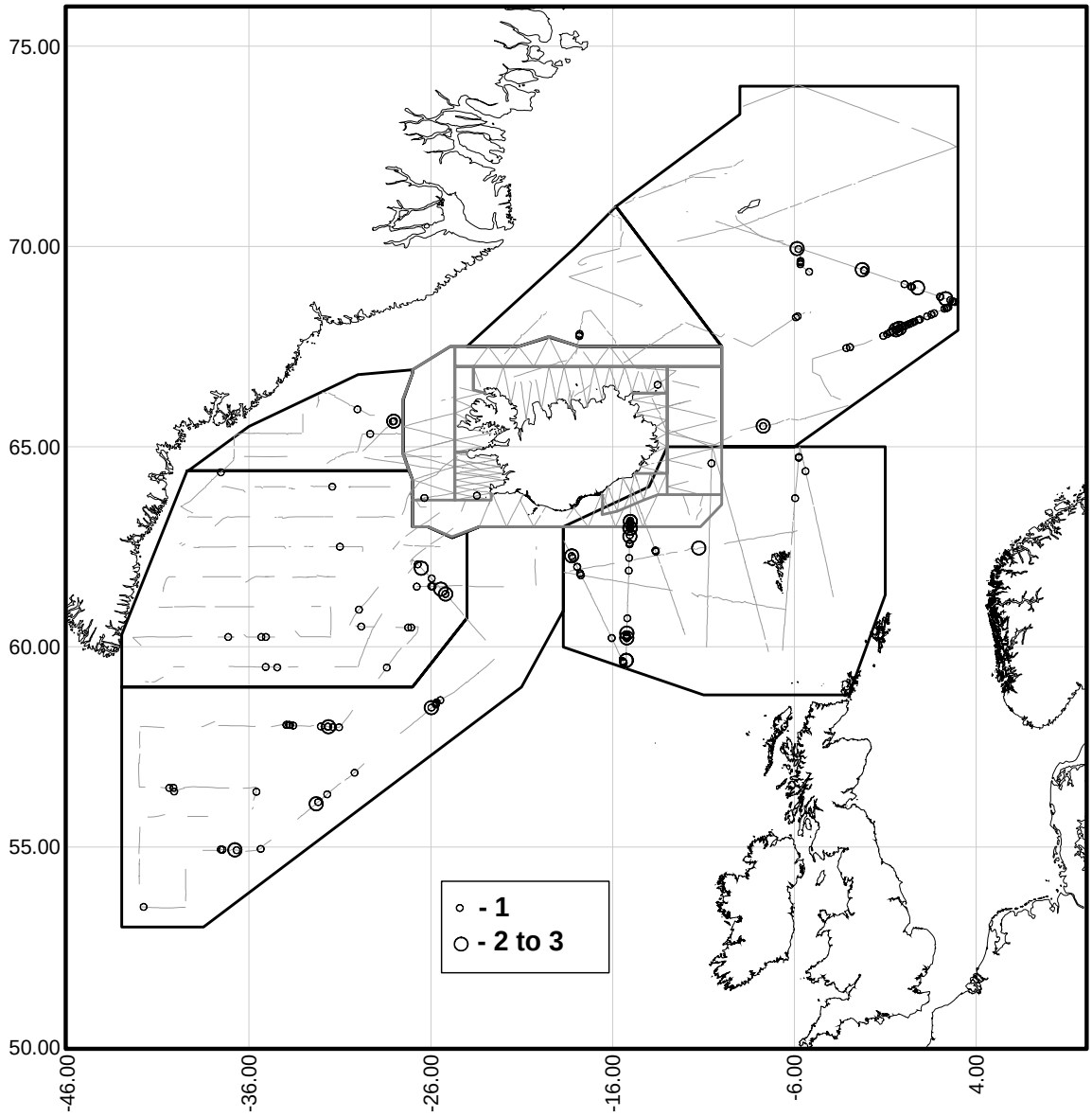

Fig. 7. Distribution of sightings of sperm whales from NASS-2001.

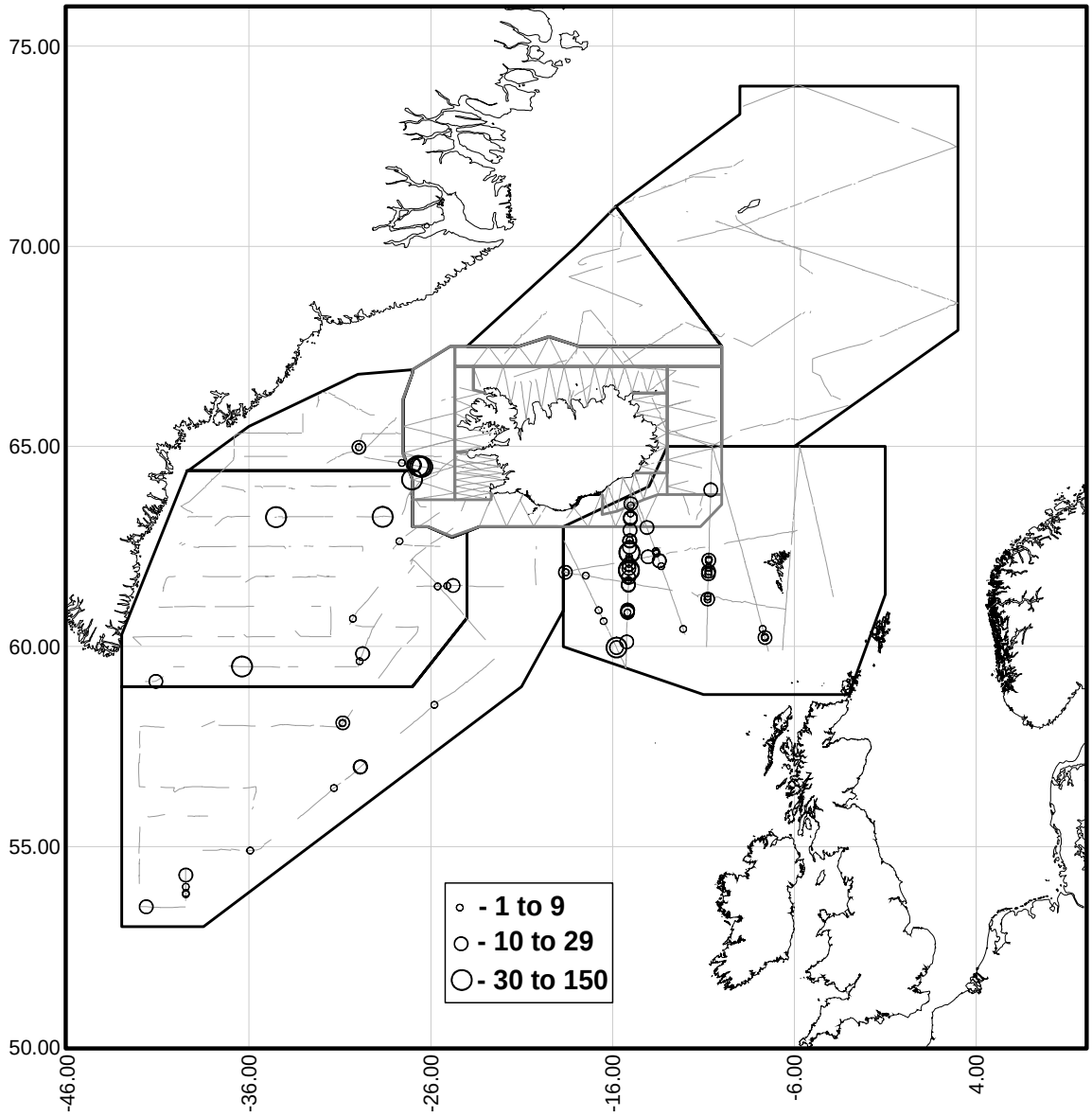

Fig. 8. Distribution of sightings of long-finned pilot whales from NASS-2001.

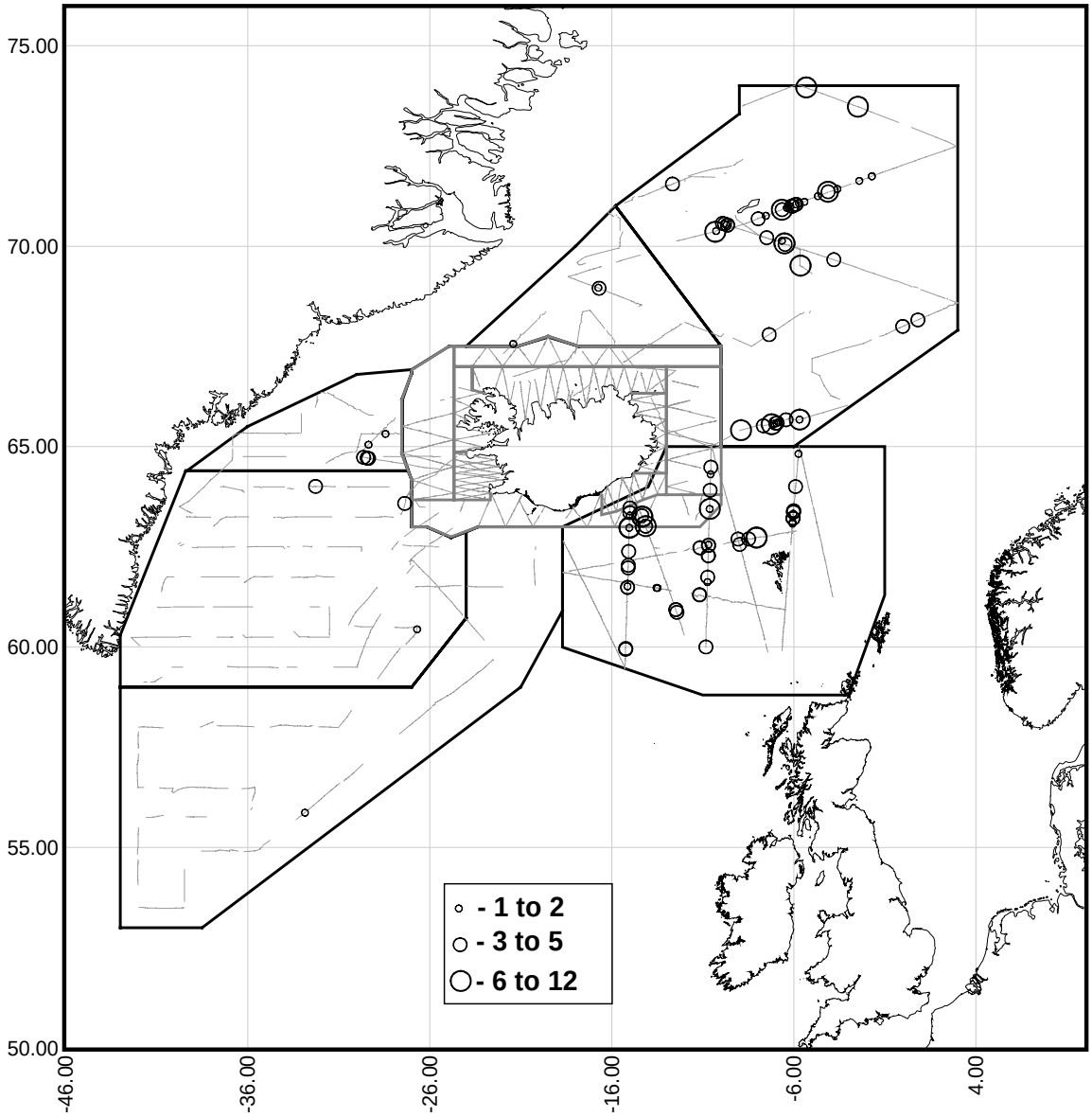

Fig. 9. Distribution of sightings of northern bottlenose whales from NASS-2001.

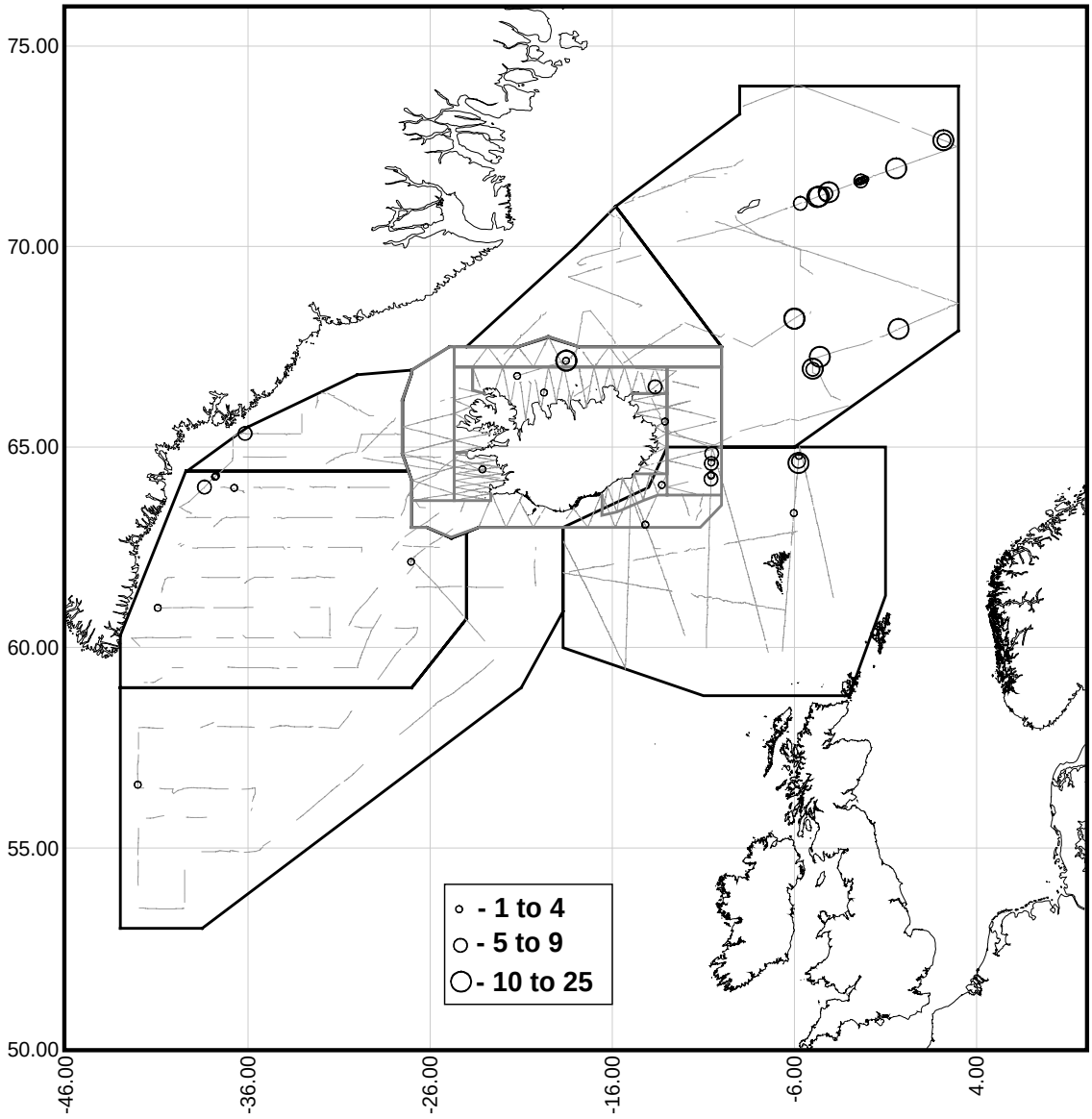

Fig. 10. Distribution of sightings of killer whales from NASS-2001.

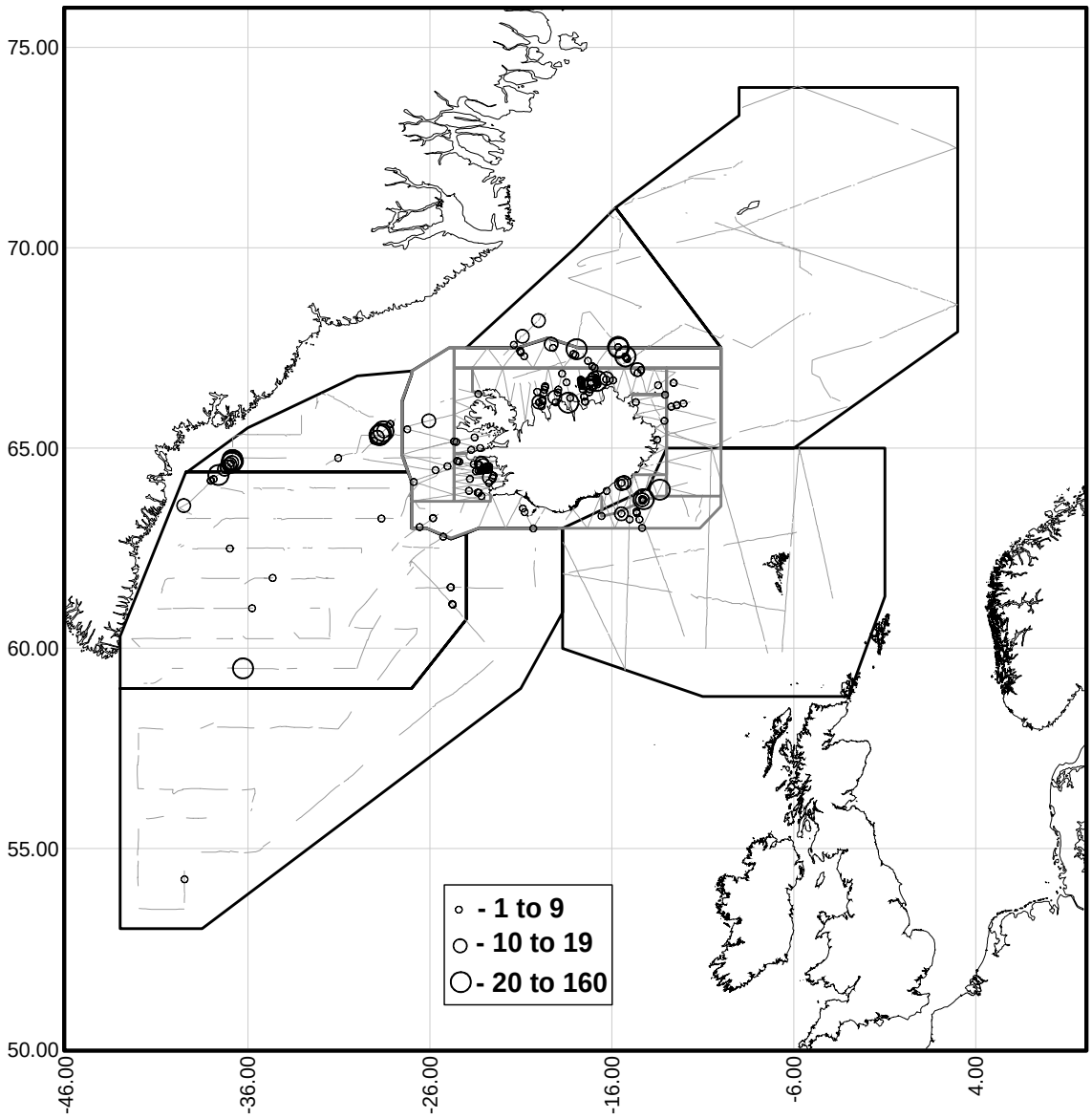

Fig. 11. Distribution of sightings of white-beaked dolphins from NASS-2001.

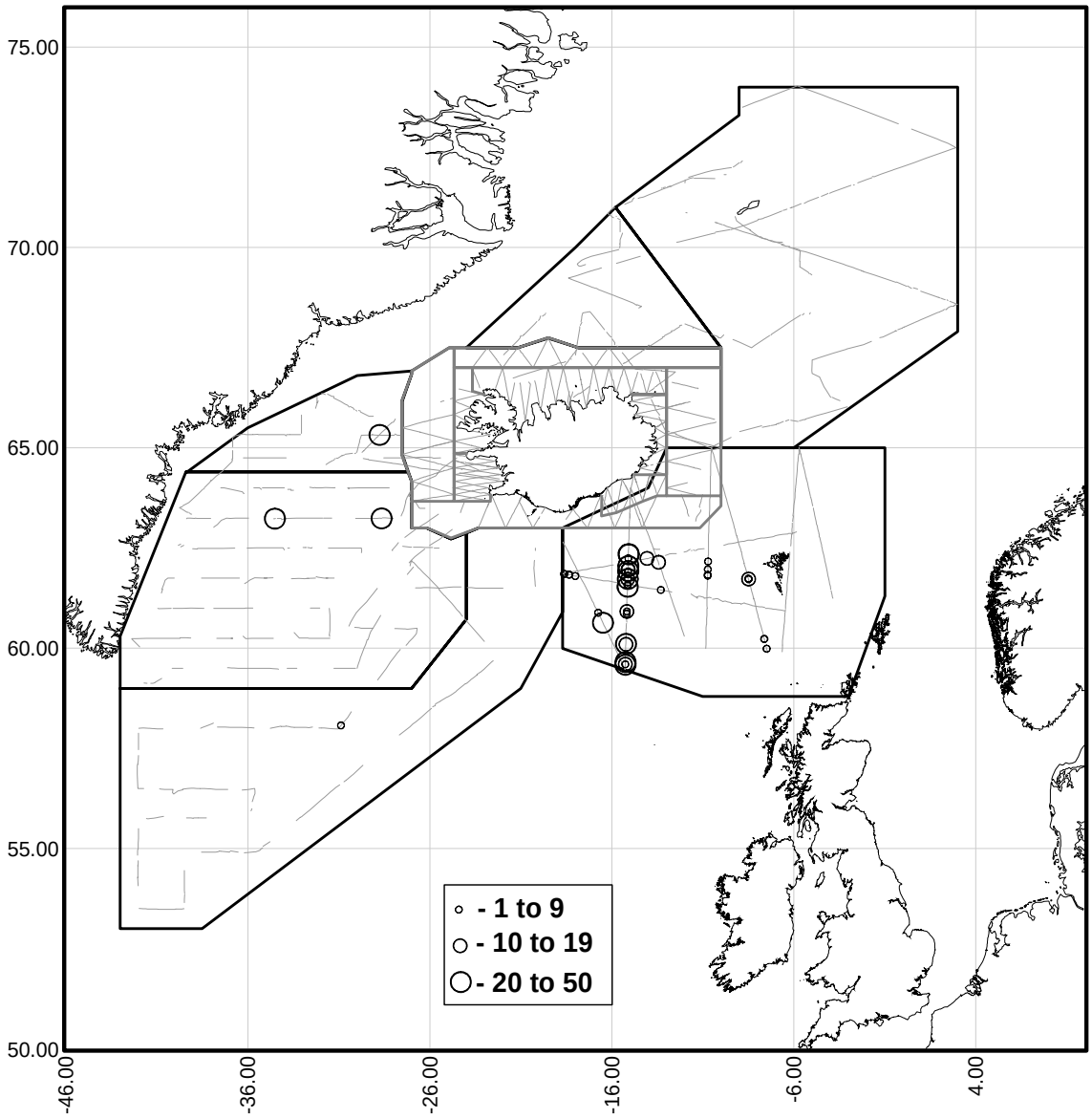

Fig. 12. Distribution of sightings of white-sided dolphins from NASS-2001.

Appendix 1

AGENDA

1. Opening remarks
2. Adoption of Agenda
3. Appointment of Rapporteur
4. Review of available documents and reports
5. Survey reports
6. Minke whales
   - ii. Ship surveys
   - iii. Aerial survey
   - iv. Combined estimates
   - v. Trends in abundance
7. Fin whales
   - i. 2001 ship survey
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8. Other species
   - i. Humpback whale
   - ii. *Lagenorhynchus* dolphins
   - iii. Pilot whales
   - iv. Sperm whales
   - v. Bottlenose whales
   - vi. Killer whales
9. Evaluation of survey methodology
   - i. Ship surveys
   - ii. Aerial surveys
   - iii. Recommendations for future surveys
10. Publication of survey results
11. Other business
12. Adoption of report.

Appendix 2

LIST OF DOCUMENTS

SC/10/AE/1	List of participants
SC/10/AE/2	Draft agenda
SC/10/AE/3	Draft list of documents
SC/10/AE/4	Not available
SC/10/AE/5	Pike, D.G., Gunnlaugsson, Th. and Víkingsson, G.A. A preliminary estimate of the abundance of minke whales (*Balaenoptera acutorostrata*) from the NASS-2001 Icelandic aerial survey
SC/10/AE/6	Pike, D.G., Gunnlaugsson, Th. and Víkingsson, G.A. A re-calculation of the abundance of minke whales (*Balaenoptera acutorostrata*) from the NASS-95 Icelandic ship survey.
SC/10/AE/7	Pike, D.G., Gunnlaugsson, Th. and Víkingsson, G.A. Trends in the distribution and relative abundance of minke whales (*Balaenoptera acutorostrata*) from NASS Icelandic aerial surveys, 1986-2001.
SC/10/AE/8	Gunnlaugsson, Th., Víkingsson, G.A., Pike, D.G., Desportes, G., Mikkelsen, B. and Bloch, D. Fin Whale Abundance in the North Atlantic, Estimated from Icelandic and Faroese NASS-2001 Vessel Surveys.
SC/10/AE/9	Pike, D.G., Gunnlaugsson, Th. and Víkingsson, G.A. Preliminary estimates of the abundance of humpback whales (*Megaptera novaengliae*) and *Lagenorhyncus* spp. dolphins from the NASS-2001 Icelandic aerial survey.
SC/10/AE/10	Gunnlaugsson, Th., Halldórsson, S.D., Ólafsdóttir, D. and Víkingsson, G.A. NASS 2001 Icelandic shipboard survey report
SC/10/AE/11.	Desportes, G. An evaluation of the methodology used in the NASS-2001 Faroese ship survey.
SC/10/AE/12	Pike, D.G., and Víkingsson, G.A. The NASS-2001 Icelandic aerial survey: Introduction and evaluation.
SC/10/AE/13	Gunnlaugsson, Th., Víkingsson, G.A., Pike, D.G., Desportes, G., Mikkelsen, B. and Bloch, D. Sperm whale abundance in the North Atlantic, estimated from Icelandic and Faeroese NASS-2001 shipboard surveys
SC/10/AE/14	Trends in humpback whale (*Megaptera novaeangliae*) sightings rates from aerial surveys in Icelandic waters during 1986-2001.
SC/10/AE/15	Desportes, G., Mikkelsen, B., Bloch, D., Danielsen, J., Hansen, J. and Mouritsen, R. Survey report from the Faroese shipboard survey of NASS-2001.

Appendix 3

RECOMMENDATIONS FOR IMPROVEMENT OF THE NASS SHIPBOARD SURVEYS

(Compiled from SC/10/AE/10, SC/10/AE/11 and comments at the meeting)

Vessels, platforms and equipment

1. Vessel AF2 should be fitted with an extra outdoor tracking platform around or below the present one.
2. The tracking platform should be at a higher elevation than the primary platform.
3. Every effort should be made to reduce vibration that interferes with the use of mounted reticule binoculars on the tracking platform. This should be tested before the survey begins, and modified if necessary.
4. The platforms should be placed in such a way that they do not obscure the radar. This creates problems in conducting distance experiments.

Procedures

1. The importance of recording re-sightings should be stressed.
2. The special protocol for sperm whales must be further elaborated. It is very important that the ultimate fate of each sighting be recorded, i.e. was it observed when abeam? Where was it last see? What effort/speed/heading changes were made prior to the last sighting?
3. Observers who prefer to use binoculars and are talented at picking up sightings at long distances should be used as trackers.

Data forms and data recording

1. Cloud coverage ahead should be recorded as percentage separate from weather codes for mist and rain. Cloud coverage should be categorised as high or low cloud.
2. Swell height should be recorded as 1 digit, m, and wavelength as 2 digits, m.
3. Cue type should be recorded in mnemonic codes.
4. Record movement as: H, T, X = head or tail, L, R, S = side.
5. Use ISO8606 standard for date and time.
6. Missing codes: flipper as cue, wind direction, closure and confirmed sightings, code for likely duplicate between platforms, code of qualifying success of closure.
7. Use decimal points, not commas, in all records.
8. Procedures for data entry and display should be streamlined, so the observers can be better monitored by the cruise leader. Simple software should be developed for daily display of angle and distance data. More automation of data recording would be useful, for example time and angle of sighting.
9. Recording of meteorological data should be automated.
10. The recording of echo-sounder data periodically throughout the survey should be considered.

Training

1. More effort should be dedicated to observer training, and some ship time should be used. Several days of land training, followed by 1 to 2 days of training/experimental survey at sea would be ideal. The observers should understand how the data will be used, so they will understand the importance of strictly following survey procedures.

Other

Request permission to enter any other countries territorial waters at least 6 months prior to the survey.

Appendix 4

RECOMMENDATIONS FOR IMPROVEMENT OF THE NASS ICELANDIC AERIAL CUE COUNTING SURVEY

(Compiled from SC/10/AE/12 and comments at the meeting)

Survey design and strategy

1. The offshore blocks are often difficult to complete because of weather. In future surveys the idea of covering these blocks by ship should be considered. It might also be possible to have some flexibility in the ship survey design, so that it could cover some of the offshore aerial blocks if necessary. This would require close communication between the aerial and ship survey teams. It could be decided beforehand that if a block had not been completed by the last week of the survey, it would be re-assigned to the ship survey.
2. The survey crew must be flexible and mobile, and able to move at short notice to areas of Iceland that have suitable survey weather.
3. Weather forecasting services should be used to choose an area where surveying might be possible. The crew should then contact the Icelandic "Coast Guard" to obtain telephone numbers of fishing vessels in the prospective survey area, then contact the vessels in the area to get an on-the-spot account of the conditions. In doing this, one must remember that a fisherman's idea of "good" weather may be quite different from that required for survey. The Captain should be asked to describe the waves he is experiencing, not just to report the Beaufort sea state.
4. A general prioritisation plan for the blocks, rated on minke whale density, would be:

i) Blocks 1, 4 and 8;
ii) Other inshore blocks: 2, 6 and 9;
iii) Offshore blocks: 3, 5 and 7.

Of course this prioritisation scheme will be different if other species (e.g. humpback whales and dolphins) become more important in future surveys.

Platform and equipment

1. A lighter, less bulky system, that records voice and data directly on the computer hard drive, is required. It should be designed so that it is possible for more than one person to transcribe data simultaneously (using separate computers).
2. Data acquisition and entry should be further automated so that it is feasible for the cruise leader to view displays of angle and distance data on a daily basis, in order to monitor the observers properly. Alternatively, a non-flying crewmember should be dedicated to data transcription and data entry during the survey.
3. Sightings close to the platform are of course most important in both cue counting and line transect methodologies. The use of an observer at a belly window should therefore be considered.
4. An electronic declinometer with a digital display should be tested and used if it performs adequately. This should be easier to read quickly than the

analogue models.

5. A method of directly measuring or more easily and accurately estimating angle from the nose of the airplane to the sighting should be developed.

Procedures

1. The use of double-platform methods should be considered an absolute necessity in these surveys. The Cruise Leader can observe full-time if he/she records all environmental observations verbally rather than using paper forms.
2. A special protocol should be developed for the pilot, which would allow him/her to record his/her sightings verbally without taking measurements, preferably with the use of a voice-activated microphone. The pilot would be instructed to describe his/her sightings as they occur, including estimations of declination and head angle.
3. The primary and secondary platforms should be visually isolated from one another. This can be easily achieved with the use of a curtain.
4. To achieve aural isolation of primary and secondary observers, the observers should be instructed to hold the recording microphone close to the mouth and to speak only as loudly as required to make an audible recording. The intercom microphone should be pushed out of the way while on effort
5. Consideration should be given to using 3 primary observers on the flights, and rotating them approximately every 30 minutes, or between survey legs, so that each observer would have a 30-minute rest after every hour of observation. This would reduce the risk of observer fatigue affecting sighting efficiency on long flights.
6. It is important for the primary observers to change seats at least every day and preferably more frequently, for variation in seating position and so that all combinations of primary - secondary observer are used.
7. The observers' data should be transcribed and entered electronically on a daily basis. This would allow the cruise leader to examine the angle, location and distance distributions of the sightings, to make sure the observers are covering their areas adequately, and not favouring certain angles or areas in the sighting field. This will require changes in equipment (see above).
8. Sitting in one position for hours on end can be extremely uncomfortable, and this increases observer fatigue and reduces the effectiveness of the observers. The observers should be encouraged to use pillows or other means to increase the comfort of their observing stations.
9. If dolphins are a priority in future surveys, closings should be made on a subsample of dolphin groups to confirm species identification and calibrate group size estimation.
10. If cue counting (as opposed to line transect) methods are realistically expected to be of use for humpback and other whales, the necessity for the observers to count blows should be emphasised. Otherwise, the protocol should be changed such that the observers are instructed simply to count groups of whales as in a line transect.

Observer training

1. Observer training is extremely important. At least 2 days of ground training

and 5-10 hours of in-flight training are required.

2. A general training plan is as follows:
3. Class training- survey plan, theory, data forms, etc.
4. Ground training. Conducted in the plane, on the ground. Observers record sightings of targets dragged under the wing of the plane. Subsequently, they go over the recordings and transcribe the data. Problems with procedures are identified and the process is repeated.
5. In-flight training. Conducted over Faxaflói Bay in a 2-3 hour flight. Should be done in full survey mode. Afterwards, the observers go over their recordings and transcribe their data. Problems are identified, and the process is repeated if necessary.

Other

1. It would be extremely useful to apply satellite tags to minke whales in the same area and simultaneous with the survey. This would give time/place specific estimates of cueing rate and surfacing times that could be of use in a cue counting or line transect survey. It could also provide an estimate of inter-block movements over the course of the survey, and could provide data with which to estimate $g(0)$ by attempting to sight tagged whales.
2. The feasibility of a digital photographic survey, as an alternative to cue counting, should be investigated.

ANNEX 2

REPORT OF THE WORKSHOP ON MODELLING MARINE MAMMAL - FISHERIES INTERACTIONS IN THE NORTH ATLANTIC

Reykjavík, 13-15 September, 2002

1. OPENING REMARKS

Chairman Lars Walløe welcomed the members (see section 5.6) to the Workshop, and summarised the background to the present Workshop.

A 1996 Working Group (NAMMCO 1998) looked at the feeding ecology of minke whales, harp and hooded seals and found that there were many uncertainties involved in estimating consumption by these species. It also considered the use of multi-species models to assess species interactions in the Barents Sea and Central North Atlantic. The Scientific Committee, based on the results from the Working Group, concluded that minke whales, harp seals and hooded seals in the North Atlantic might have substantial direct and/or indirect effects on commercial fish stocks.

In 1997, the Council requested the Scientific Committee to pay special attention to studies related to competition and the economic aspects of marine mammal-fisheries interactions. The Scientific Committee, in response, convened a Working Group on the Economic Aspects of Marine Mammal - Fisheries Interactions (NAMMCO 1999). This Working Group considered bio-economic models of varying complexity and associated ecosystem models, and concluded that "many of the analyses were in a preliminary stage and should only be taken as first indications". They further concluded that, despite the preliminary nature of the results, the emerging cost-benefit figures warranted serious consideration, as the overall costs to the fishing, whaling and sealing industries incurred by not whaling and/or not sealing could be quite considerable, and that the effects due to predation could be an important part of the overall picture.

At its 8th meeting in Oslo, September 1998, the NAMMCO Council tasked the Scientific Committee with providing advice on the following:

i) to identify the most important sources of uncertainty and gaps in knowledge with respect to the economic evaluation of harvesting marine mammals in different areas;

ii) to advise on research required to fill such gaps, both in terms of refinement of ecological and economic models, and collection of basic biological and economic data required as inputs for the models,

iii) to discuss specific areas where the present state of knowledge may allow quantification of the economic aspects of marine mammal-fisheries interaction;

   a) what could be the economic consequences of a total stop in harp seal exploitation, versus different levels of continued sustainable harvest?

   b) what could be the economic consequences of different levels of sustainable harvest vs. no exploitation of minke whales?

The Working Group on the Economic Aspects of Marine Mammal - Fisheries Interactions met in February 2000 to consider parts i) and ii) of the request. One of the conclusions of the Working Group was that significant uncertainties remain in the calculation of consumption by marine mammals, and this uncertainty was the most important factor hindering the development of models linking consumption with fishery economics (NAMMCO 2001). Considering this conclusion, the Scientific Committee decided to convene a workshop to further investigate the methodological and analytical problems in estimating consumption by marine mammals. This workshop resulted in concrete recommendations to estimate consumption by North Atlantic marine mammals, and a list of research priorities to refine existing estimates (NAMMCO 2002).

The Scientific Committee views the next logical step in this process to be a review of how presently available ecosystem models can be adapted for quantifying marine mammal - fishery interactions. Several different candidate models have so far been identified: the Icelandic BORMICON, the Norwegian MULTSPEC and Scenario Barents Sea, and the ECOPATH/ECOSIM model. The properties of different models will be discussed and compared, as well as the desired spatial and temporal resolutions. The Workshop is tasked with choosing a preferred modelling approach for analysing the ecological role of minke whales, harp and hooded seals, and other marine mammal species in the North Atlantic, identifying required input data and its precision, and recommending a process for further development of the model. Lack of knowledge of important input data will also be identified. An important consideration will be predator choice of prey given a range of available prey and prey densities. The Chairman emphasised that the Working Group should not expect to review results or make quantitative predictions at this meeting, but should rather focus on methodological problems.

2. ADOPTION OF AGENDA

The Draft Agenda (Appendix 1) was adopted with minor changes.

3. APPOINTMENT OF RAPPORTEUR

Daniel Pike, Scientific Secretary of NAMMCO, was appointed as Rapporteur.

4. REVIEW OF AVAILABLE DOCUMENTS

Documents available to the Workshop are listed in Appendix 2.

5. PROGRESS AFTER THE 2001 NAMMCO WORKSHOP

Analysis of NASS-2001 data continued within the NAMMCO Scientific Committee Working Group on Abundance Estimates (See Annex 1). Preliminary estimates have been calculated for fin, sperm and humpback whales. New abundance estimates on the most important species including minke whales will be finalised in 2003.

Haug reported on recent research carried out in Norway on harp and hooded seals and minke whales:

- Collections to continue the time series on minke whale diet and body condition performed during commercial whaling in the North Sea, Barents Sea and around Spitsbergen.
- A new abundance estimate (based on sightings surveys in 1996-2001) for Northeast Atlantic minke whales is now available.
- Ecological studies (diets, body condition) of harp and hooded seals in pack ice waters of the Greenland Sea in the period between moult and breeding (July-February) had been continued. Modelling of total consumption of the two Greenland Sea stocks, based on new data and experience from similar work in the Northwest Atlantic and in the Barents Sea, is in progress.
- Abundance of Greenland Sea harp seals were assessed using aerial strip transect methods to estimate the 2002 pup production.
- Assessment of Barents Sea harp seal predation on resources in open waters are in progress: aerial surveys to map the distribution of seals are performed simultaneous with ship borne surveys designed to estimate the abundance and distribution of capelin.
- Demographic and ecological (primarily body condition) data collected seals from taken in the commercial hunt.

Víkingsson reported on recent research in Iceland:

- Sampling of stomach content of hooded seals in Icelandic waters was continued in 2002.
- Laboratory analysis of material sampled from by-caught white-beaked dolphins off Iceland is nearly complete.

Mikkelsen reported on recent research in the Faroe Islands. In the Faroes a scientific sampling programme was initiated in 2001 on white-sided dolphins taken in the traditional hunt.

The Chairman and others present reported that the Scientific Committee of the International Whaling Commission had held a workshop on a similar theme in La Jolla, California in June 2002. It was planned that the report from that meeting should be available [in confidence, pending its submission to the IWC] for this workshop in order to avoid duplication of effort, however the report has not yet been completed. The Chairman summarised some of the results from the meeting for the group. A general conclusion from the meeting was that interactions between marine mammals are a topic worthy of quantitative scientific investigation. The workshop investigated several candidate models, including MULTSPEC and ECOPATH/ECOSIM.

6. INTRODUCTION TO MULTI-SPECIES MODELS

The Working Group considered descriptions of the range of available multi-species modelling tools. This includes two general classes of models typified by the Minimum Realistic Models (MRM) on the one hand and the ECOSIM/ECOPATH approach on the other. The MRM class includes MULTISPEC, BORMICON/GADGET and

Scenario Barents Sea. These models share the characteristics of being system specific, modelling only a small component of the ecosystem for a specific purpose, and treating lower trophic levels and primary production as constant or varying stochastically. In contrast, ECOPATH/ECOSIM is an all-inclusive approach that incorporates lower trophic levels and primary production.

i. Minimum Realistic Models - Doug Butterworth

The concept of Minimum Realistic Models was first introduced in the context of evaluating the potential impact of a then expanding fur seal population on the important fishery for hake off the west coast of South Africa at a Benguela Ecology Programme Workshop on Seal-Fishery Biological Interactions held in Cape Town in 1991 (Butterworth and Harwood 1991). The implementation of the approach to this problem is detailed in Punt and Butterworth (1995).

The key feature of the MRM approach is that consideration is restricted to species considered likely to have important interactions with the species of interest, Cape hake in this instance. Thus, in addition to the impact of fisheries, the model included seals and a grouping representing large predatory fish. Together with the effects of cannibalism and inter-species predation for the 2 hake species, the model then accounted for over 90% of the natural mortality of hake. The different components of the model were described at the level of detail considered necessary to capture key aspects of the dynamics: thus fully age-structured models were used for the 2 hake species to capture cannibalism and inter-species predation effects accurately, whereas the grouping of other predatory fish was modelled in a lumped fashion by only 2 linked components of small and large fish.

The analysis was set within the simulation framework of a 20 year projection under a feedback control rule for setting TACs for the hake fishery, to ascertain whether possible increases in the sustainable yield of hake in response to a seal cull might actually be realised. The robustness of the results obtained was checked by repeating the simulations for variants of the underlying MRM that involved primarily consideration of alternative values for parameters whose magnitude was uncertain.

In this initial implementation of the approach, the work had proved complex and lengthy. This, however, was seen as a consequence of the complexities of age-structured modelling of hake cannibalism and inter-species predation in this instance, rather than necessarily a general feature of the approach.

Discussion

The Working Group noted that since the models of this type provide a partial view of the ecosystem, the cost of ignoring un-modelled, weak ecosystem links should be assessed. More research in this area is required, possibly using simulation studies involving both strong and weak ecosystem links.

The approach as applied to the Benguela ecosystem demonstrated the requirement for ecosystem-specific models. A generic approach could not have captured the unique dynamics of even this rather simple ecosystem model. Any model is likely to require a

large amount of work to adapt it to a particular area. Generalised modelling approaches must be very flexible and have accessible, easily modifiable coding so they can be adapted to specific situations.

ii. MULTSPEC - Sigurd Tjelmeland

MULTSPEC, which was established at the National Institute of Marine Research in Bergen, is a general-purpose multi-species simulator for the Barents Sea. It was initially designed to be a tool for calculating the spawning biomass of capelin, but later interactions between fish and marine mammals were included. At present the species capelin, cod, herring, polar cod, minke whales and harp seals are modelled.

The original application could be handled fairly rigorously since the general features of the migration were known – the capelin has to cross the entire population of immature cod to spawn every year and since there is a survey on immature cod during February, yielding not only the geographical distribution of cod but also a large quantity of stomach samples of cod.

When marine mammals were added rather counter-intuitive results were obtained. There proved to be a larger gain in the cod fishery by removing the seal population from the model than by removing the whale population, even if the whales eat more cod. Also, decreasing the suitability of herring as food for cod had a larger effect on the yield from the fisheries than removing the marine mammals altogether. The reason for this lies with the cod-herring-capelin dynamics. In order to get the marine mammals – fish interactions right the fish-fish interactions must be right.

At present MULTSPEC is resting and there has not been active work on this model for several years due to lack of resources. An attractive alternative for a geographically structured simulator for the Barents Sea is to implement the GADGET model. In addition simpler models are needed, like the Scenario model developed at the Norwegian Computing Centre. In view of the scarcity of resources this model should preferably be cast into the GADGET code.

In addition to these general-purpose simulators or simulators tailored to the marine mammals – fish issue, it is interesting to include consumption by marine mammals in fish assessment models. At the IWC cetaceans – fish workshop in La Jolla this year an attempt was made to include predation of Norwegian spring spawning herring by minke whales in the assessment model SeaStar. In the short term predation of capelin by harp seal will be included into the assessment model for capelin – Bifrost – on an experimental basis.

Discussion

It was noted that a version of MULTSPEC was being adapted for use in the western Pacific ecosystem by Japan, but no information on this effort was provided to the workshop.

The idea of including marine mammal predation in traditional single species assessment models such as Bifrost was considered a useful avenue of research by the

Working Group. This should improve the performance of these models if predation by marine mammals is a significant component of natural mortality. In addition it will have the added side effect of increasing the demand for effective modelling of marine mammal predation, thereby assisting in the development of the scenario models of most interest to this group.

The rationale for including marine mammals in models, in preference to other predators such as seabirds, was discussed. It was considered that marine mammals would be a more productive focus for modelling in the candidate areas because the magnitude of their consumption is much greater than that of seabirds (Barrett *et al.* 2002). In addition, more and better data are available for marine mammals than for seabirds in the regions of interest.

The use of marine mammal populations as indicators of general ecosystem health was discussed by the Working Group. For some species, such as harp seals, there is a large amount of historical data on abundance and productivity, which could be correlated with fishery assessment and possibly climatic data. It was noted that Russian scientists are pursuing this with harp seals, and that marine mammals are used as indicators in the Antarctic. However it was considered that in most cases it will be easier to monitor the ecosystem components of interest, such as fish stocks, directly, rather than relying on an indirect indicator such as marine mammals. There may be significant time lags in the response of population parameters to ecosystem change in long-lived marine mammals. In addition, adaptive prey switching may mask significant ecosystem changes, as has been noted for both harp seals and minke whales.

iii. Scenario Barents Sea - Tore Schweder

Scenario Barents Sea is a series of projects at the Norwegian Computing Center in Oslo with extensive help and advice from Institute of Marine Research in Bergen and Tromsø. The two first projects were carried out from 1993 to 1999, while a new project funded by the ministry of Fisheries will be carried out in the period 2002-2004. In this new project harp seals will be included in the model. The aim is to study how various management strategies for sealing and whaling will affect the Norwegian fish-fisheries, on the basis of our current knowledge and data concerning the population dynamics of, and interaction between, harp seals, minke whales, cod, herring and capelin. Another aim is to identify holes in our knowledge, and pressing data needs.

The previous projects compared management strategies for cod and herring (Hagen *et al* 1998); studied direct and indirect effects of minke whale abundance on cod and herring fisheries (Schweder *et al* 2000a); studied the effects on these fisheries of re-tuning the IWC/RMP for minke whales (Schweder *et al* 1998); and also compared management strategies with respect to long term resource rent, harvest capacity, catch, and abundance of cod (Schweder *et al* MS 2000b).

When studying the interaction between management of marine mammals and fish, the model in the previous projects has 4 species: cod, capelin, herring and minke whales. The fish populations are age and length distributed, while the minke whale is age and sex distributed. The time step is one month, and there are two areas (The Barents Sea

and parts of the Norwegian Sea). There is a food web with minke whales as top predators, consuming herring, capelin and cod according to a non-linear consumption function in available prey abundance. The consumption function for minke whales is roughly estimated. The opportunistic minke whale may forage on plankton and other fish than cod, capelin or herring, and is modelled as having carrying capacity and demographic parameters independent of the status of the fish stocks in the model.

The fish-fisheries are managed by fixed VPA-based fishing mortalities (cod and herring) and CAPTOOL (capelin), while minke whaling is managed according to the Revised Management Procedure (RMP) of the IWC (Schweder *et al* 1998). The model is stochastic in fish recruitment and in survey indices for minke whales. The model is simulated over 100-year periods in a number of scenarios spanned by 9 experimental factors. The core of the experimental design is an orthogonal array with 27 points. The primary study variable is the tuning of the RMP, and the response variables are catches and stock sizes of cod, herring and minke whale. The responses are taken as yearly means over the last 90 years of the period.

When the tuning of the RMP is changed from the current level of targeting the final stock at 72% of carrying capacity to 60%, the annual catch of whales increases with some 300 animals, while the annual catch of cod increases with some 0.1 million tons on the average. For herring, no clear main effect was found on catch or mortality rate. The catch of cod is estimated to increase in annual mean with some 6 tons when the whale stock is reduced with one animal. Schweder *et al.* (MS 2000b) found further that minke whale abundance affects the cod fishery in a similar linear fashion over a wide range of minke whale abundance. The results concerning the effects on the cod and herring fisheries must be taken as tentative since the ecosystem model used could be improved, and so could the strategies for managing the fisheries.

Discussion

The Working Group noted that the lack of data on some aspects of the model, particularly the response of predators to prey availability, had led the modellers to use plausible ranges rather than estimated values for some parameters in the model. While this was considered to be acceptable in a scenario-testing model such as this, the sensitivity of the model to these parameters needs to be thoroughly assessed. Also, the lack of data on these parameters should be used to identify research priorities to fill in the gaps in knowledge.

Fishers are assumed to tailor their catches to quota decisions in some of the versions of this model, and no “economic behaviour” of fishers is included. Economic behaviour is, however, included in one version of the model. Although outside the scope of fish-marine mammal interaction, it was found of considerable interest that Schweder *et al* (MS 2000b) found that quota capping could produce substantial gains in the economic performance of the fishery, accompanied by a strengthening of the stock.

The fact that minke whales and harp seals were included as exogenous components of the model, so that their population parameters were not affected by changes in prey

availability, was considered problematic by some members of the Working Group. Changes in harp seal condition, productivity and migration patterns have been associated with the collapse of the capelin stock in the Barents Sea in the 1980s, which apparently resulted in the "seal invasions" of the Norwegian coast. While it was considered that there is evidence to show that there are responses in seal fecundity and survival rates in response to food availability, there are insufficient data to model these responses at present, and they could be included in the model only with very great uncertainty. No such responses have been demonstrated for minke whales. Nevertheless the Working Group concurred that inclusion of endogenous responses to prey availability where such responses have been demonstrated would make the model more realistic.

The model is incomplete and does not include all the major predators of cod, herring and capelin, or even all marine mammal predators. If minke whale predation is reduced, it is possible that other predators, such as dolphins, killer whales or seals, may respond by increasing their abundance and predation pressure on these species. Therefore it was considered important that the main top predators are included in simulation models such as this. This will be difficult because the predators will have to be included as endogenous components that respond to competition by other predators. The functional relationships to model these responses are simply not available for most species, and certainly not for dolphins for which very little information is available. This should be considered a caveat in the use of models in which the top trophic levels are not completely specified. To include harp seals would help. But, if harp seals are exogenous to the fish system, a reduction in minke whales will not allow harp seals to respond to the accompanying availability of food. It is therefore good reasons to make the harp seal an endogenous component in the model. Schweder responded that attempts would be made to collect the information necessary to model the response of harp seals on fish abundance, and that the aim is to complete the model in this respect. Whether this could be done in the project Scenario C is however uncertain.

The linearity of the response of cod and herring catch over a wide range of minke whale abundance was considered surprising by the Working Group. It was originally thought that the removal of herring by minke whales would improve the survival of juvenile capelin, thereby enhancing the productivity of the cod stock, however this effect was not observed in the simulations. However the observed response is heavily dependent on the functional response to prey availability by minke whales, and data on this are poor. The meeting recommended that the sensitivity of model output to different assumptions for the form of functional response should be investigated.

Scenario – GADGET perspective

The new scenario project aims at updating the existing scenario model for the Barents Sea and the Norwegian Sea with improved predation structure and population structure. The project has limited funding, and will not accomplish much more than putting together the currently available data and knowledge in the existing framework, and to carry out simulation experiments.

The long term goal however is to transport the various components of the model to the system GADGET, and to build the model further in this system, at least when the GADGET allows the Scenario model to be used as a testbed (operating model) for management procedures. This will have a number of advantages. Some of these are:

- GADGET is likely to be better documented than the Scenario program and is expected to be better maintained and improved.
- With a general and openly available system tailored to fisheries, the Scenario model is likely to be more transparent when implemented in GADGET than in the present C-code.
- In the GADGET system a data warehouse is available. This enables unified and easy access to fisheries data at appropriate levels of aggregation, which facilitates future updating of predation functions and other aspects of the model.
- Future data might allow migration patterns to be estimated for the various stocks. Implemented in GADGET, the Scenario model might model the spatial overlap explicitly.
- GADGET is general, and does not set limits to the number of components. In a GADGET implementation additional species such as like killer whale or shrimp might more easily be included.

For the future development of the Scenario model, parts of the model could be run over the Internet. This would enable models of subsystems to reside in their home institutions, and be improved and updated there.

iv. BORMICON/GADGET - Gunnar Stefansson

The first data-driven multi-species models to be applied to fisheries data, such as MSVPA[1], did not include any statistical techniques but used ad-hoc methods for estimating parameters. Since these models only included predation mortality but not the effects of consumption on the growth of the predators, they had some serious shortcomings in terms of applications to Arcto-boreal systems given the highly variable growth in these systems, sometimes attributed to variation in food availability. Further, since there are no spatial features in MSVPA, it is at best difficult to account for highly variable spatial overlap of predators and their prey.

[1] MSVPA is a multispecies extension of Virtual Population Analysis (VPA). VPA involves estimation of annual recruitments to a fish population by summing fishery catches-at-age up for each cohort while at the same time making allowance for losses to natural mortality (M) each year. In standard VPA, M is customarily taken to have a constant value, independent of year and age. Multi-species VPA performs this estimation simultaneously for a number of species. The important extension to standard VPA is that consumption by a predator species is explicitly included in the computation of natural mortality losses for the corresponding year and age for the prey species in question, so that M for each species becomes both age- and year- dependent. These computations are based on diet composition studies.

The first such model to be applied to Arcto-boreal systems, MULTSPEC, addressed some of these shortcomings by being a spatially explicit model. MULTSPEC also applied statistical estimation methods through the use of likelihood functions, albeit in a rather limited sense. MULTSPEC was also fairly specific in terms of what were prey and predators, making additions and model changes somewhat difficult.

When initially developing models for Icelandic waters, a decision was made to address all of these issues at the design stage. The first model, BORMICON (A BOReal MIgration and CONsumption model) was a multi-species, spatially dis-aggregated model which took into account growth as a function of consumption and allowed the user to specify their preferred likelihood functions. A deliberate design issue was to be able to accommodate quite different components of population dynamics models and different likelihoods for different species and data sets, thus allowing for varying levels of knowledge and different data collection schemes. Thus a fairly generic environment for model development was designed, rather than a single model. This environment is a flexible platform for models (or model components) of biological processes. Although a model implemented in GADGET can be quite complex, this is inevitable when testing complex hypotheses. It is simply not possible to evaluate the importance of temporal - spatial overlap without explicitly taking these into account.

BORMICON was subsequently used as a basis for FLEXIBEST for assessments of Northeast Arctic cod. The various developments have been co-ordinated as a European project with a current program (2000 - 2003) which includes models such as the initial FLEXIBEST and BORMICON as special implementations. It is important to note that any specific growth models, suitability functions etc. are intended to be modules, with alternative formulations easily added.

Within the European framework, the goals were to: Obtain a model/tool which describes the most important features of the system as it relates to fish; Understand the models/limitations; Understand the underlying multi-species dynamics; but not at this stage to obtain an assessment toolbox.

The current program, GADGET (Globally Applicable Area-Disaggregated Generic Ecosystem Evaluation Tool), is a fully parametric forward simulation model (and can therefore in principle be run without any data). A simulation results in population trends by species, size class, age group, area and time step. These trends can subsequently be compared to data using appropriate likelihood functions, eventually maximising the likelihood functions to obtain parameter estimates.

Consumption within GADGET is modelled using suitability functions and mortality can be due to predation, other natural causes or fishing.

Growth is implemented via movement up through length classes and can depend on consumption, with several growth update mechanisms already available.

Migration is implemented through movement matrices. In principle these can vary by time step, but in typical case studies they are assumed to be fixed in time.

The species life cycle has not been closed within GADGET at present so spawning, as currently implemented, only results in weight loss. It is foreseen that during the coming year the first models with a closed life cycle will be tested, with larval drift of fish implemented through exogenous hydrography-driven movement matrices.

The model is completely symmetric across species and areas so that, for example, a predator's behaviour is defined only through associated data sets and parameterisation.

Parameters are estimated using maximum likelihood. These likelihood functions are sometimes quite difficult and can be multi-modal due to several reasons, requiring global minimisation algorithms for initial estimation, followed by local minimisation algorithms which zoom in on the minimum. Given that individual simulations can require considerable computing power, a parallel minimisation algorithm has been designed.

A number of likelihood functions have thus been implemented but recent work indicates that many common data sets defy the most common statistical assumptions. It has also been seen that model "stiffness" implies that too much weight given to a data source (i.e. incorrect likelihood function) can lead to widely varying population trends, which is in stark contrast to well-known results in linear statistical models where incorrect variance assumptions tend to be of minor significance.

Since GADGET is a parametric model, it can in principle run without data. For data-poor species, highly detailed models which require large numbers of parameters cannot be reasonably implemented and the modeller is forced to use simpler models with fewer parameters. For some marine species highly detailed data are available and these can then be used to fine-tune highly detailed models.

Given the data requirements, it is obvious that if data is entered into GADGET data files by hand or using manual extractions from raw data bases, revisions of spatial aggregations or length groupings will require considerable revisions of the data files. For this reason a data warehouse has been defined in such a way that it consists of mildly aggregated data in standardised tables. Extraction routines for assessment purposes have been written and extraction routines for GADGET are under development.

Current case studies within the European framework include Icelandic waters, the Celtic Sea and North Sea herring. For each of these areas a multi-species model is being implemented using GADGET with data extracted from standardised tables in each area.

Current implementations include several species within Icelandic waters (single species, single area up through 3-species in 10 areas), and Barents Sea cod. In spite of known problems, the program is currently used for assessments in several cases where no alternatives exist to account for known important processes within the system.

Future work includes obtaining reliable estimates of uncertainty, implementations of tagged sub-populations, development of new likelihood functions and closing the life cycle. The most promising approach to estimating uncertainty appears to be bootstrapping but considerable work is needed in this area, given the correlated nature of the measurements.

Discussion

The Working Group was impressed with the scope and ambition of this project in attempting to establish a framework for ecosystem models of various levels of complexity. When put to use, the GADGET system will provide a strong and unified platform for data handling, scenario modelling and simulation, and model fitting. Such a unified platform is certainly welcome, and so is the information technology that is put together in GADGET. However, even with good information technology as GADGET, much work remains for the particular modelling exercises. Scenario- and assessment models are necessarily case specific, and all the specifics must be worked out for each particular case.

It was noted that marine mammals have not been included in any of the GADGET case studies to date. Earlier attempts to include cetaceans in multi-species modelling in Icelandic waters (Stefansson *et al.* 1997) have shown that more data on diet of minke whales is required for the Icelandic area.

The simultaneous maximisation of likelihood for up to hundreds of parameters in non-linear models is problematic due to local maxima and other difficulties. To allow the parameters of the model to be fitted simultaneously to the collection of relevant but fragmented data is highly desirable, but very taxing. In GADGET, global maximisation is carried out, which was applauded. However, with a highly non-Gaussian likelihood, the information matrix is not particularly informative of the statistical properties of parameter estimates. One intermediate course would be to fit parts of the model to relevant parts of the data, and then to reserve only a limited number of parameters for the final simultaneous fitting. The other parameters would then be kept constant at their partial estimates. In the discussion, it was pointed out that when a sound likelihood function is available, the scene is set for valid parametric bootstrapping. Statistical measures of uncertainty in conclusions are thus much better obtained by bootstrapping than by calculating the Hessian at the computed maximum.

The scope for a Bayesian approach to quantifying the uncertainty in conclusions was also mentioned. This might be possible through simulation when well-argued prior distributions are available.

v. ECOPATH/ECOSIM

ECOPATH is an equilibrium approach to multi-species modelling. Mass balance equations are used, essentially relating production by some species to predation by others under the assumption that the system is in a steady state. Unlike the models discussed above, ECOPATH also considers the lower trophic components of the ecosystem, for example plankton. ECOSIM builds upon this approach, but drops the equilibrium assumption so that the system is modelled by a set of coupled differential

equations. Attempts had been made to have a scientist experienced with applications of ECOPATH and ECOSIM to make a presentation to the meeting, but unfortunately without success.

Discussion

Potentially ECOSIM could provide a basis to provide advice on marine mammal-fisheries interactions. An advantage of the package is the structured framework it provides to setting out species-specific inputs required for multi-species modelling. Potential disadvantages discussed included the built-in functional forms for species interactions, and simplified treatment of age-structure, that may not be appropriate for the particular cases to be considered. Another problem is the large number of parameter values that need to be specified; some of these may have an appreciable impact on outputs, and the default suggestions provided by the package may not be the most appropriate in all circumstances. Furthermore, ECOSIM is at the other end of the spectrum of possible models compared to the single species approaches currently used as the basis for management advice, in the sense that it attempts to model all elements of the ecosystem. A less expansive approach, building from single-species experience and without immediately attempting to incorporate phyto- and zooplankton dynamics, might be more appropriate as an initial advance from current practice.

7. PREY SELECTION PROCESSES

Prey selection by minke whales in the Barents Sea – Ulf Lindstrøm

To elucidate the prey selection function of minke whales, Norwegian Institute of Fisheries and Aquaculture performed studies of minke whale foraging dynamics in selected areas in the southern Barents Sea in 1998 and 1999. Stomach contents were sampled onboard commercial whaling vessels whereas the resource availability was assessed using standard acoustic surveys by research vessels. Three different approaches were applied to make inferences about minke whale selectivity:

1. Chesson's selectivity index,
2. Multivariate statistics
3. Empirical Bayesian statistics.

The first approach involves use of the bootstrap, i.e., the index was calculated for each prey type and then tests were carried out to look for deviations from random feeding. This was done by calculating approximate 95% confidence intervals for the expected index value for each prey. These were compared with the expected index value on the assumption of random feeding. The prey availability was estimated by bootstrap sampling of assumed independent resource samples.

The second approach involves constructing multivariate confidence bounds (ellipsoids) to delimit expected prey proportions in the diet and the environment and thereby reveal significant differences. For the diet analysis, the bootstrap was applied to obtain precision measures of the dietary prey proportions, whereas in the spatial analysis of prey densities, intrinsic geostatistics were applied; statistically homogenous conditions are assumed. Because whaling and resource sampling were not simultaneous, the whales may have experienced different resource availability than

observed during the resource mapping. To account for this uncertainty, the variation between realisations of the prey density process was included in addition to the sampling uncertainty for each realisation.

The methods applied in the two previous approaches were based on extensive use of the bootstrap, but since use of the bootstrap is strongly dependent on a sufficient number of independent samples, a simplified binomial model was applied to the diet analysis with special emphasis on capelin. The expected proportion of capelin in the diet was estimated as the number of whale stomachs dominated by capelin divided by the total number of non-empty stomachs. For a given capelin proportion in the sea (q), the p-value can be found by a classical method. That is, the simulated distribution of capelin proportions in the sea, provided by the methodology in previous approach, was considered the *a priori* distribution for the unknown q. The appropriate p-value was the defined as the mean in the posterior distribution of p conditional on q

The prey selectivity of minke whales was analysed over various levels of spatial resolution, which turned out to be important considering the results from three consecutive resource surveys performed in one small-scale area. The spatial pattern may change rapidly, particularly with respect to pelagic shoaling fish such as capelin and herring.

It was concluded that there is an apparent advantage of multivariate over univariate comparisons of prey preference when strong prey correlations are involved in the diet and the environment. Accordingly, if the sample size is sufficiently large, the multivariate approach is recommended. On the other hand, with few whale samples the Bayesian statistical approach seems promising.

Discussion

Haug noted that large-scale spatial and temporal correlations between prey abundance and minke whale diet have been observed. In years when strong year classes of juvenile herring area available, herring can dominate the diet in areas where the distribution of minke whales and juvenile herring overlap. The proportion of capelin in the diet also tracks capelin abundance to a large extent.

Studies of the type presented provide estimates of prey selectivity at the micro-scale. However, multi-species models require estimates of such consumption functions at the macro-scale (the spatio-temporal scale of the strata adopted for the population dynamics modelling). Conversion of the results from micro-scale experiments on selectivity to yield macro-scale estimates is not straightforward, as the results will depend on the spatio-temporal distributions of predators and their different prey species, and the former may alter in response to changes in the latter. In the short to medium term, the prey selectivity values needed for multi-species models will likely need to be based on the aggregated approach of regression analyses relating observed changes in annual average predator diet to varying prey abundances provided by assessments - hopefully such data will provide sufficient contrast to allow for reasonable estimates to be obtained by this approach. Nevertheless, detailed, smaller scale efforts should be continued to elucidate the mechanisms behind prey selectivity,

and to allow the conversion approach to be applied in the longer term. It was noted that a potential problem with the aggregated approach was the non-random nature of the diet data, which is dependent on samples taken from the commercial hunt. There is evidence from sightings surveys and incidental observations that whales occur in areas where they are rarely hunted. While a randomised-sampling program to obtain diet samples would be preferable, it was considered highly unlikely that this could be realised in the near term.

The available data on minke whale diet covers a limited seasonal window, and this could confound the estimation of consumption functions. Most diet data comes from commercial whaling in May and June, and there is almost no data from the rest of the year. In addition, catch locations from commercial whaling conducted after the 1950s show that the location of catches can vary substantially from year to year. In some years, catches were concentrated close to the Finnmark coast, while in other years whales were caught farther north and east in the Barents Sea. This reflects variation in the distribution of minke whales from year to year, which in turn may be due to changes in prey distribution. Since it is not possible to sample animals throughout the year on an annual basis, a basic assumption will have to be made that consumption patterns do not vary temporally or spatially, until this assumption can be tested.

Simulation of minke whale suitability with special emphasis on herring and capelin – Ulf Lindstrøm

The main objective of this preliminary simulation study is to understand how local and large-scale predator-prey processes are linked, and preferably come up with a "running average" estimate of the functional response.

The model will include a resource simulation model and a minke whale foraging model. The simulation of resource densities is performed by using intrinsic geostatistics, as described before, whereas a dynamic state variable model will be used to simulate the minke whale's foraging behaviour. The resource simulation model and ten resource simulations were presented at this meeting along with a simple random walk model.

Discussion

The Working Group noted that the simulation-based estimation of selection parameters should be a valuable if ambitious approach in this area. Using realistic simulated prey fields, the behaviour of simulated predators can be modified until the resulting simulated diet observations mimic those realised in the field under similar conditions. The resulting functions should be extendable to other areas and prey conditions within the range of the simulation testing.

It was noted however that there may be a need for greater complexity than that presently incorporated in the model. Suggestions included including a prey depletion function, such that predators deserted the food patch once density fell beyond a threshold level; inclusion of 3 dimensional foraging; modification of searching behaviour upon encountering a patch; incorporation of state variables such as stomach fullness; and incorporation of temporal change in the prey field. While this will

introduce further complexity into the model the results should more realistically mimic observed behaviour.

Modelling diet choice and consumption functions – Tore Schweder

There is a rich economic literature on human choice- and consumer behaviour, and there is a wealth of experience in estimating models on both the individual level and on the aggregated level. The economic paradigm of rationality is that humans make their choices on the basis of utility maximisation within the options available in the situation, and under budget constraints. A weak form of this paradigm might also be appealing to the biologist when modelling animal behaviour on the micro level. One might therefore think that the economic and econometric literature on choice- and consumer behaviour provides guidance when predation, diet choice and foraging is to be modelled for fish and marine mammals (and also terrestrial species).

Ben-Akiva and Lerman (1985) give an introduction to the theory of discrete choice behaviour. To fix ideas, consider the following constructed adaptation of this theory. A minke whale might feed on krill, herring, capelin, gadoids or other food. In this situation, it faces a choice set of 5 alternatives. Each food item is characterised by an (observable) attribute vector x, say of calorie density, local abundance and patchiness. Each choice alternative is associated with a potential utility to the whale. This alternative-specific utility is modelled as v(x)+r, where r is a random component covering unobservable individual taste variation and other sources of random variation, and v transforms the vector of attributes to a scalar utility. The theory is then that the minke whale chooses that food item within the choice set that maximises the individual whale's utility. A popular specification is that the random components are independent over alternatives, and follow a Gumbel distribution. In this case, the probability that the whale chooses a particular food item follows the multinomial logit distribution. A consequence is that the popular axiom of independence of irrelevant alternatives (IIA) is satisfied. This means that, everything else equal, the conditional probability P(capelin | herring or capelin) is the same whether krill, or gadoids are open options – and correspondingly, any other conditional choice probability is fixed regardless of which other options that are available.

In a further development, Dagsvik and Strøm (MS 2002) draw on the psychophysical literature, and find theoretical support for specific functional forms for the function v transforming attributes to utilities. The logarithmic transform is a possible function. It leads to multinomial logistic choice models for which the logits are linear in log prey fattiness, log prey density, log prey patchiness etc.

The example with minke whale diet choice is meant to illustrate that this economic theory might have something to offer, rather than a solution to the very difficult problem of estimating diet choice and selectivity functions in minke whales.

Discussion

It was questioned whether the IIA assumption would indeed hold true for marine mammals. In a case where there are two prey items for which selectivity is the same, the relative selectivity for each will be lower if both are present because the predator

will not distinguish between them. In response Schweder pointed out that with the same selectivity the two items would be considered to be the same under this scheme, and that classification of prey items would not necessarily be by species. Two or more species could be grouped together if they are not distinguished by the predator.

There was some discussion over whether baleen whales in particular actually do select prey, or whether the observed apparent selection might be the result of applying 2 dimensional dynamics to a 3 dimensional distribution of predators and prey. Also, the range at which prey items can be distinguished might be quite short, which would make selection unlikely. However it was noted that the observed positive selectivity of minke whales for capelin was in some cases so extreme that it could not be a result of depth distribution, since the depth distribution of capelin and herring was similar. Also, the selection may not occur at a distance, but prey might be ingested and then rejected.

8. RECOMMENDED MODELLING APPROACH FOR NAMMCO

In reviewing the amount of multi-species modelling work and associated applications to management decisions that had been conducted world-wide over the past several years, the Working Group noted a much lower than expected activity in this area. This was considered surprising given the emphasis politicians and management authorities have placed on multi-species (ecosystem) approaches to the management of marine resources. While the principle of multi-species management seems to be widely accepted, the practical aspects of putting it into practice lag far behind the rhetoric. The Working Group emphasised that progress in this area will not be made unless significant additional resources are dedicated to it.

The Working Group identified the following desirable general features of a modelling approach that would be applicable to analysing marine mammal – fisheries interactions in the candidate areas of the North Atlantic:

- Flexibility of functions for prey selection that can be manipulated by the modeller;
- Flexibility of age structuring, from fully age structured to fully aggregated;
- Accessible source code and transparency of operation- the model must not be a “black box”;
- Able to be tailored to the area and species of interest, rather than generic;
- Model interactions accounting for most of the natural mortality of the fish species of concern;
- Spatial and temporal resolution tailored to the target species, with flexibility for changing resolution.
- Uncertainty in data and model structure is reflected in the results.

Considering the data available or likely to become available in the foreseeable future, the Working Group favoured the approach of using a limited model that encompassed only the major species of interest, as opposed to an all-encompassing model where all or most species are included, as a basis for potential management advice in the short to medium term. This approach can be described as a Minimum Realistic-type model, as exemplified by Scenario Barents Sea, MULTSPEC and BORMICON. It was

considered that the data demands of a more comprehensive model would be so great for the model to be sufficiently realistic and estimable that there was little likelihood of them ever being satisfied. This would necessitate more guesswork in the specification of such a model. Other components of the ecosystem that are not explicitly modelled, such as primary production or zooplankton, could be left as constant, allowed to vary randomly or linked to environmental covariates. While the output of such a model could not be expected to predict all aspects of future states of the ecosystem, they will be useful for testing management scenarios where the abundances of target species are manipulated.

Some members voiced the concern that the development of ecosystem models without sufficient data in some components would produce results that might be used by inappropriately by managers, who might not understand the level of uncertainty in the results even if it is specified. It was suggested that it would be better to wait until the required data is gathered before proceeding to ecosystem modelling. Other members noted that even models in which some components are parameterised with “plausible ranges” can be useful in determining the sensitivity of the model to variation in parameters, and thus in determining the most important gaps in knowledge. It was agreed that the two activities should proceed simultaneously: that is, the data gaps identified in previous workshops should be filled by dedicated studies, while modelling can proceed in candidate areas, even with partial data, as long as the uncertainty of the results is emphasised and integrated in the results. In this way, modelling approaches can be refined and the reliability of the results will improve as more data is gathered.

There was agreement that the continued development of the Scenario Barents Sea model should be a priority, with emphasis on incorporating the predation of harp seals in the model. The model would be improved by including harp seals and possibly minke whales as endogenous in the model in the sense that their life history parameters would be affected by variation in food supply. However this would be subject to considerable uncertainty given the current lack of information on these effects. The Working Group also recommended that this model be transferred to the GADGET platform after the current round of development has been completed. This will facilitate interface with present single species assessment models, and enhance the transparency of the model and the possibilities for future development. It was noted that such a transfer will require additional resources that are not currently available.

In addition to the above the Working Group recommended the development of a second, more general North Atlantic "template" model based on the GADGET platform. This spatially homogeneous model would include species important in candidate applications to West and East Greenland, Iceland and the Barents and North Seas. However the abundance of these species would be varied between the areas according to available information. The quality of the available input data varies greatly between areas, and in cases where little information is available, plausible ranges would be used. It will be crucial to capture the full range of uncertainty in these ranges.

In areas where data is lacking, such as West Greenland, the main use of such a model will be to identify the sensitivities to variation in input parameters, and thus to assist in the setting of priorities for research. In Icelandic waters, where better data is available for fish but data on marine mammal diets and prey selection are scarce, such a model will serve the same purpose but also generate preliminary scenario results for management. For the relatively data-rich Barents Sea area, the model will augment the main Scenario Barents Sea modelling effort.

The Working Group recommended the establishment of a planning group to develop the specifications of the template model, should the project proceed. It was emphasised however that the development of such a model is not presently planned or budgeted, and will require additional resources to proceed.

To summarise, the Working Group settled on a two-pronged approach to modelling marine mammal – fisheries interactions in the candidate areas. The first approach will be the further development of the Scenario Barents Sea model, which is already proceeding but could be enhanced with additional funding. The second suggested approach is the development of a more generic, North Atlantic-wide template model based on the GADGET platform, including major fish and marine mammal species of interest from all the candidate areas. The model should be applied to areas that best suit the distribution of the candidate species, as well as available fisheries and marine mammal datasets. The model will initially serve mainly as a mode for sensitivity testing to determine the most profitable avenues for research. As more data becomes available, this model could be further developed into Minimal Realistic-type models for the candidate areas.

9. FUTURE WORK

i. Collection of input data

The Working Group reiterated the priorities for future research identified by the Scientific Committee of NAMMCO in 2001 with regard to refining the estimates of the consumption of marine mammals in the North Atlantic (NAMMCO 2002).

The functional nature of prey selection by marine mammals under varying levels of prey abundance and from mixtures of available prey was considered a further priority for further research. To derive these functions diet data must be collected in conjunction with resource surveys at appropriate temporal and spatial scales.

Migration by fish and marine mammals was considered to be one of the most important factors in modelling their interactions. A great deal of data is available for many of the major fish species, which could be analysed to develop migration models. For marine mammals, there is very little data and much more research is needed, possibly through continued satellite tagging studies.

Data warehouse

It was considered that the Data Warehouse facility offered by the GADGET platform would be an ideal platform for compiling data for future modelling efforts. The use of this facility was strongly encouraged.

Testbed

At present GADGET lacks the scenario aspect where the management process itself is modelled in prognostic simulations. Only when this option is available will it be possible to use an implement the Scenario mode for its original purpose: to compare management strategies and their related assessment machinery. Developments in this direction should be encouraged.

ii. Linkage to economic models

It was considered that discussion of the economic aspects of marine mammal-fisheries interactions would be premature until these interactions have been initially described and quantified. Once models are available that can predict the variation in target species in response to management measures, linkages to simple economic models that assess the economic consequences of the responses can be made. However it was cautioned that more complex economic models integrating the economic behaviour of fishers and markets under different conditions of resource abundance are themselves subject to great uncertainty and a subject outside the scope of the present Working Group.

10. RESEARCH NEEDS

The Working Group reiterated the research priorities identified by the NAMMCO Scientific Committee in 2001 (NAMMCO 2002). In particular the Working Group emphasised that additional information on harp seal diet and consumption in the Barents Sea is a priority to further the modelling work. In addition the Working Group identified the following priorities:

Prey selection

- theoretical and practical work on prey selection models
- development aggregated consumption functions
- migratory and spatial aspects of consumption models

Multi-species modelling

- Further work on the Scenario Barents Sea model
- Use GADGET as a framework to generate template models for candidate areas in the North Atlantic

11. ADOPTION OF REPORT

The report was approved at 18:40 on 15 September.

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Appendix 1 - **AGENDA**

1. Opening remarks
2. Adoption of Agenda
3. Appointment of Rapporteur
4. Review of available documents
5. Progress after the 2001 NAMMCO Workshop
6. Introduction to multi-species models
   - i. Minimum Realistic models- Doug Butterworth
   - ii. MULTSPEC- Sigurd Tjelmeland
   - iii. Scenario Barents Sea- Tore Schweder
   - iv. BORMICON/GADGET- Gunnar Steffansson
   - v. ECOPATH/ECOSIM
7. Prey selection processes
8. Recommended modelling approach for NAMMCO
9. Future work
   - i. Collection of input data
   - ii. Linkage to economic models
10. Research needs
11. Adoption of report

Appendix 2 - **LIST OF DOCUMENTS**

SC/10/EC/1	List of Participants
SC/10/EC/2	Agenda
SC/10/EC/3	List of Documents
SC/10/EC/4	Schweder, T. Scenario Barents Sea: Issues, approach, model, methodology. (Presentation slides)
SC/10/EC/5	Stefansson, G. DST^2 (Presentation slides)
SC/10/EC/6	Linstrøm, U., Harbitz, A. and Haug, T. Small-scale studies of minke whales (*Balaenoptera acutorostrata*) foraging behaviour in the southern Barents Sea, with particular reference to predation on capelin (*Mallotus villosus*).
SC/10/EC/7	Harbitz, A. and Lindstrøm, U. 2001. Stochastic spatial analysis of marine resources with application to minke whales (*Balaenoptera acutorostrata*) foragine: A synoptic case study from the southern Barents Sea. *Sarsia* 86:485-501.
SC/10/EC/8	Lindstrøm, U. and Haug, T. 2001. Feeding strategy and prey selectivity in common minke whales (*Balaenoptera acutorostrata*) foraging in the southern Barents Sea during early summer. *J. Cetacean Res. Manage.* 3:239-249.

SECTION 4 - NATIONAL PROGRESS REPORTS

4.1
FAROE ISLANDS - NATIONAL PROGRESS REPORT 2001

(Dorete Bloch, Bjarni Mikkelsen, Maria Dam And Jústines Olsen)

1. INTRODUCTION

This report summaries the Faroese research activities on cetaceans and pinnipeds in 2001. Since 1984, the main bulk of research on marine mammals in the Faroes has been conducted by the Zoological Department of the Faroese Museum of Natural History, supplied by the Food and Environmental Agency of the Faroes, the Faroese Fisheries Laboratory and the veterinarians involved in the pilot whaling.

2. RESEARCH

2.1 Species/stocks studied

Cetaceans

* Fin whale (*Balaenoptera physalus*) - Biopsy
* Minke whale (*Balaenoptera acotorostrata*) – By-catch, biopsy
* Sperm whale (*Physeter macrocephalus*) - Sranded animals
* Bottlenose whale (*Hyperoodon ampullatus*) – By-catch, landed animal
* Pilot whales (*Globicephala melas*) - Landed animals
* White-sided dolphins (*Lagenorhyncus acutus*) - Landed animals

2.2. Field Work

Pinnipeds

Opportunistic observations

One harbour seal was observed for several days in January. Harbour seals are seldom observed in the Faroes. Also, one bearded seal was observed in January. During the last decade, several observations are made of bearded seals in the Faroes. A juvenile Walrus was visiting the Faroes for about three weeks during March. This is the second observation of the species in the last three years.

Cetaceans

NAMMCO observation scheme

Again in 2001 the NAMMCO observation scheme was implemented. In the observation period there was one pilot whale drive, in Norðskála (23 whales), Table 1. The observer followed the Norðskála grind.

North Atlantic Sightings Surveys 2001

The fourth North Atlantic Sightings Surveys (NASS-2001) took place from end of June to end of July, as a co-operation between Iceland, Norway and the Faroes. One Faroese ship surveyed Faroese and south-east Icelandic waters for a period of 28 days (22 days on effort). It was planned that the Faroese ship should observe also inside the very northern part of the British EEZ, but, well known to everyone, this was denied by the British Government.

Opportunistic observations

As in the previous years, opportunistic sightings of whales were reported to the Museum of Natural History by various local sources. Also the year 2001 has been characterised by relatively few landing but significant observations offshore of pilot whales. And again, fin whale is the most commonly observed baleen whale in Faroese coastal and offshore waters, with the earliest pod of two observed in Vestmannasund 11. February. Minke and sei whales been also been seen. Among toothed whales, the following species have been observed: sperm whales, bottlenose whales, killer whales (in pods until 17 whales), pilot whales, white-sided dolphins, and the harbour porpoise, as permanent in Faroese waters.

Fin whales

Biopsies

A modified Larsen biopsies gun has been placed onboard the Faroese Fisheries Inspection wessel *Tjaldrið*, opportunistically taking biopsies of fin whales. In 2001, 3 biopsies were taken by *Tjaldrið*. Moreover, 1 biopsy was taken during NASS-2001 and another 5 were taken from *Tjaldrið* during the tagging operation of fin whales.

Tagging

In August 2001 four fin whales were tagged with satellite transmitters 40 n.m. east of the islands. Two tags gave usable up-links, operating for 25 and 105 days, respectively. The results showed somewhat contrary movements patterns, since the whale with the short-lived tag stayed at the 200 m depth contour, with minor north-south movements, the whole tracking period, while the other migrated south to 42°W and 21°E, a distance of 1120 n.m. covered in 73 days, before moving northward again.

Minke Whales

A minke whale drowned in a cage at a salmon farm in Skálafjørður at 14 November 2001. It was a juvenile male, measuring 735 kg in total weight and 433 cm in total length. Samples were taken of meat, blubber (30 mm thick), liver and kidney. The skeleton is stored at the museum.

Pilot whales

Sex, *skin* values and total bodylengths (cm) was recorded from all pilot whales caught in 2001, with kind assistance from the *sýslumen* and the persons valuating the whales.

Ballistic studies were made on heads of dead pilot whales to investigate the effect of different type and strength of ammunition. A new knife with a longer blade than on the traditional knife has been tried with positive results and further examinations will go on.

As in earlier years samples were taken by the Food and Environmental Agency to examine the levels of heavy metals and organochlorines. Samples of in all approx. 125 individuals were taken in connection with the drive in Vestmanna 27. June, in Miðvágur 6. July and in Bøur 11. July. From every individual sampled the tissues muscle, liver, kidney and blubber were collected. From the Vestmanna *grind*, teeth taken from the lower jaw were collected in addition.

White-sided dolphins
Sex, *skin* values and total bodylengths (cm) was recorded from all white-sided dolphins caught in 2001, with kind assistance from the *sýslumen* and the persons valuating the whales. Furthermore, biological samples for age, diet, genetic, energetic purposes, and pollution examinations, were taken from a total of 37 animals.

3. CATCH DATA

Pinnipeds
Grey seals may be shot when interacting with the salmon fish farming. However, catch reporting is not mandatory. Therefore, no catch data exist on the magnitude of this take.

Cetaceans

Table 1: Pilot whale drives in the Faroe Islands, 2001.

Date	Locality	Number of whales
1 March	Sandavágur	19
26 June	Vestmanna	95
1 July	Sandur	171
4 July	Tórshavn	59
5 July	Miðvágur	76
11 July	Bøur	186
13 July	Sandavágur	120
23 July	Bøur	112
3 August	Norðskála	23
16 September	Húsavík	35
2 October	Hvannasund	22
Total	**11 grinds**	**918 whales**

Table 2: Drives of species other than *G. melas* in the Faroe Islands, 2001			
Date	Locality	Number	Species
30 June	Klaksvík	8	L. acutus
18 July	30 nautical mile N	1	H. ampullatus
17 August	Klaksvík	6	T. truncatus
22 August	Tjaldursvík, Hovi	1	H. ampullatus
5 September	Hvannasund	18	L. acutus
6 September	Klaksvík	26	L. acutus
17 September	Gøta	48	L. acutus
18 September	Tórshavn	46	L. acutus
21 September	Hvalba	345	L. acutus
22 September	Klaksvík	55	L. acutus
Total	**1 pod**	**6**	**T. truncatus**
Total	**2 pods**	**2**	**H. ampullatus**
Total	**7 pod**	**546**	**L. acutus**

4. BY-CATCH DATA

Introduction
Questionnaires have been distributed between boats fishing in Faroese waters to examine a possible bycatch of pinnipeds and cetaceans.

By-catch scheme
The Japanese boats fishing for tunas in Faeroes waters have Faroese observers on board. These observers have been equipped with observation schemes for reporting bycatch and all marine mammals observed.

4.1 Pinnipeds
No by-catch was reported in 2001.

4.2 Cetaceans
A gill netter fishing anglerfish got a bottlenose whale as bycatch 30 nautical miles North off Kallur the 18th July. The bottlenose whale was a 8-m male, having a flat grey front, informing that it most likely was in puberty. No samples were taken.

5. ADVICE GIVEN AND MANAGEMENT MEASURES TAKEN

There were given no advice to the local authorities in 2001.

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4.2
GREENLAND - PROGRESS REPORTOM MARINE MAMMAL RESEARCH 2001

1. INTRODUCTION

This report summarises the Greenlandic research on pinnipeds and cetaceans done in 2001. Most of the research was conducted by The Greenland Institute of Natural Resources, but some projects also involved DFO (Department of Fisheries and Oceans, Canada), The Danish Environmental Research Institute (Department of Arctic Environment), Denmark, Faroese Museum of Natural History, Hafrannsoknastofnunin (Iceland), Havforskningsinstituttet (Norway) and Biodinamica, Rio de Janeiro. The catch numbers are from 2000, since the catches for 2001 are not yet available.

2. RESEARCH

2.1 Species and stocks studied

Pinnipeds

Walrus *Odobenus rosmarus* – Northeast Greenland

Cetaceans

Narwhal *Monodon monoceros* – Creswell Bay - Inglefield Bredning (North Canada and North Greenland)
Beluga *Dephinapterus leucas* - Creswell Bay (North Canada)
Minke Whale *Balaenoptera acutorostrata* – NE Atlantic
Fin Whale *Balaenoptera physalus* – North Atlantic
Humback Whale *Megaptera novaeangliae* – NE and South Atlantic
Bowhead Whale *Balaena mysticetus* – Disko Bay - Foxe Basin
(West Greenland and East Canada)

2.2 Field Work

Pinnipeds

In August 2001, the Greenland Institute of Natural Resources and the Danish Environmental Research Institute studied the energy expenditure of free-roaming walruses at two terrestrial haul-out sites in NE Greenland. Deuterium water and doubly labelled water were used for studies of the energetics of seven male walruses at their inshore mollusc banks. At the same time the activity of these study animals was continuously monitored by use of satellite-linked radio-transmitters and dive-recorders that were downloaded in the field. Furthermore, scuba divers studied the walrus foraging activity under-water for estimation of food consumption.

Cetaceans

Tagging

The following whale species have been instrumented with satellite transmitters from the Greenland Institute of Natural Resources in 2001. With the exception of the Norwegian tagging all instrumentation were done by personnel from GINR.

Species	*Number of whales*	*Month*	*Area*	*Country*	*Co-operators*
Bowhead whale	7 (6 with double tags)	May	Disko Bay	Greenland	
Bowhead whale	6	June	Foxe Basin	Canada	Department of Fisheries and Oceans
Beluga	8	August	Creswell Bay	Canada	DFO, National Environmental Research Institute
Narwhal	12	August	Creswell Bay	Canada	DFO, NERI
Fin whale	4	August	NE Atlantic	Faroe Isles	Faroese Museum of Natural History
Fin whale	3	July	North Atlantic	Iceland	Hafrannsoknastofnunnin
Minke whale	1	August	NE Atlantic	Norway	Havforskningsinsti-tuttet
Fin whale	1	August	NE Atlantic	Norway	Havforskningsinsti-tuttet
Humpback whale	1	August	NE Atlantic	Norway	Havforskningsinsti-tuttet
Minke whale	2	August	North Atlantic	Iceland	Hafrannsoknastofnunnin
Fin whale	1	August	Disko Bay	Greenland	
Humpback whales	1	November	South Atlantic	Brazil	Biodinamica, Rio de Janeiro

Surveys

An aerial survey for narwhals was successfully completed in Inglefield Bredning, Qaanaaq, in August 2001. The survey utilised a specially developed technique where two large format digital cameras continuously photographed the sea surface. The photos are spatially oriented to allow for calculation of area coverage and exact geographic positions. The 12,000 photos obtained were later examined and the whales (171 sightings) were enumerated from the images. The survey is corrected for submerged whales with data obtained from satellite transmitters and from instrumentation of narwhals with time-depth-recorders. Visibility of whales at various depths was tested with dummy silhouettes of different size categories of narwhals

2.3 Research results

Pinnipeds

Based on food consumed per dive and satellite-telemetered data on movement and diving activity, the estimate of daily food consumption of a 1,200 kg walrus was 57 kg (95% CI: 41 - 72 kg) wet weight bivalve biomass, or 4.7% (95% CI: 3.3 - 5.9%) of

total walrus body mass (Born, E.W., S. Rysgaard, G. Ehlmé, M. Sejr, M. Acquarone and N. Levermann (submitted) Underwater observations of foraging free-living walruses (*Odobenus rosmarus*) including estimates of their food consumption. Submitted to Journal of Animal Ecology).

Cetaceans

Seven bowhead whales were instrumented with satellite transmitters in north-western Disko Bay, West Greenland, May 2001. The movements within Disko Bay showed that the tagged whales preferred the northern part of the bay. Two of the tags were successful in tracking two of the whales during migration. The two whales moved from Disko Bay to northern Canada in ten days; they left Disko Bay nine days apart, and took different routes across Baffin Nay to the southern part of the North Water just east of the entrance to Lancaster Sound.

One fin whale was instrumented with a satellite transmitter the 24th of August 2001 near Aasiaat (68.74 N 52.72 W) in West Greenland. The whale stayed in the coastal area around Aasiaat until the 9th of September, before it travel approximately 400 km to the south in less than eight days, to an area (65.35 N 53.40 W) between Maniitsoq and Nuuk. Here it stayed for eight days until contact was lost. This movement resembles that of the fin whale that was tagged in 2000, except that the southward migration was approximately one month earlier in 2001 than in 2000.

Two narwhals initially tagged in August 2000 in northern Canada were tracked by satellite through September 2001, providing a record-long tracking of a cetacean. The two whales moved together and stayed in the are same area during winter and spring and returned to the tagging site in July.

3. CATCH DATA

For ringed seals the East Greenland population is here defined as ringed seals that are caught in East Greenland or in one of the three southernmost municipalities on the West coast, whereas the rest belongs to the Baffin Bay population. Hooded seals are only considered East Atlantic if they are caught north of Ammassalik. All harp seals caught north of Ammassalik are considered as coming from the Greenland Sea population, whereas catches from Ammassalik are split fifty-fifty between the Greenland Sea and the West Atlantic populations.

Reported catches in 2000 were:

Pinnipeds

Walrus: East Greenland: 7. Mid- and Southwest Greenland: 196. Avanersuaq:126.
Ringed seal: East Greenland Population: 16,284. Baffin Bay Population: 64,112.
Hooded seals: East Atlantic: 29. West Atlantic: 5,805
Harp seals (adult): Greenland Sea: 219.West Atlantic: 43,217.
Harp seals (Juvenile): Greenland Sea: 1,070. West Atlantic: 55,372.
Harbour seals: 124.
Bearded seals: 2,695

Cetaceans
Narwhals: East Greenland: 39. West Greenland: 561.
Belugas: East Greenland : 4. West Greenland : 606.
Harbour porpoises: 1,607.
Pilot Whales: 5 (all West Greenland)
Fin Whales: 7 (all West Greenland)
Minke Whales: East Greenland: 14. West Greenland: 136.

4. BY-CATCH DATA

Cetaceans
Humback Whales: 2: West Greenland (Bycatch in fishing gear).

5. ADVICE GIVEN AND MANAGEMENT MEASURES TAKEN

None

6. PUBLICATIONS AND DOCUMENTS

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4.3
ICELAND - PROGRESS REPORT ON MARINE MAMMAL RESEARCH IN 2001

Compiled by Gísli A. Víkingsson and Droplaug Ólafsdóttir

1. INTRODUCTION

The following are reports on studies conducted by or in co-operation with the Marine Research Institute (MRI), the Research Committee for Biological Seafood Quality (RCBSQ), and the Icelandic Institute of Natural History (INH) Reykjavík, Iceland.

2. RESEARCH

2.1 Species/stocks studied

Pinnipeds

Hooded seal (*Cystophora cristata*)
Grey seal (*Halichoerus grypus)*
Harbour seal (*Phoca vitulina*)

Cetaceans

Blue whale (*Balaenoptera musculus*)
Fin whale (*Balaenoptera physalus*)
Minke whale (*Balaenoptera acutorostrata*)
Humpback whale (*Megaptera novaeangliae*)
Sperm whales (*Physeter macrocephalus*)
Long-finned pilot whale (*Globicephala melas*)
Killer whale (*Orcinus orca*)
White-beaked dolphins (*Lagenorhyncus albirostris*)
Harbour porpoise (*Phocoena phocoena*)

2.2 Field Work

Pinnipeds

No sampling or other fieldwork was conducted on behalf of the RCBSQ, which has been responsible for most pinniped research in Iceland in recent decades. Contrary to its decision from last year, the committee decided to continue its scientific activities including monitoring of seal stocks. A sightings survey for grey seals will take place in October 2002, and a survey for harbour seals is scheduled in 2003.

Cetaceans

Iceland participated in the fourth North Atlantic Sightings Survey (NASS-2001) in the summer of 2001. Other participating nations were the Faroe Islands and Norway. Design and planning of the survey took place under the auspices of the Scientific Committee of NAMMCO as well as the analysis of results which is still ongoing (see SC/10/8 and NAMMCO Annual Report 2001). The Icelandic part of the shipboard sighting survey was conducted from three research vessels in Icelandic and adjacent waters in the period 20 June to 29 July 2001. A total of 14 cetacean species were identified during a total survey effort of 7,470.5 nautical miles. Simultaneously with

the shipboard survey, aerial survey was conducted in the Icelandic coastal area. A total of 537 primary sightings of at least 9 species were made during 110 searching hours in the aerial survey.

Information on stranded or beached whales at the Icelandic coast in 2001 was collected by the MRI and INH. These include one sperm whale, two minke whales, two Northern Bottlenose whales and four white-beaked dolphins.

Long term studies on blue whales involving photo-identification, biopsy sampling and satellite tracking for studies on population structure, migration and behaviour were continued. These studies are conducted in co-operation with Richard Sears, Mingan Island Cetacean Study Inc., Canada (photo-id), Per Pallsböll, University of California, Berkeley (genetics) and M. P. Heide-Jörgensen, Greenland Nature Research Institute (satellite tracking). During 30 June - 8 July 2000 fieldwork was conducted in coastal waters off west Iceland. In addition to sampling for photo-identification of blue and humpback whales 4 skin biopsies were collected and satellite tags were placed on three blue whales. A total of 38 biopsies from blue whales have been sampled in this area during 1997-2000.

Attempts were made to instrument three fin whales with satellite tags in July 2001 during the sightings survey NASS-2001. Signals were received from only one of the three tags and only for one day. Two minke whales were marked with the same type of satellite tags north off Iceland 12 and 15 August 2001. The transmitting duration from the two transmitters was 16 and 60 days respectively.

A long-term photo-id study on killer whales was continued. In 2001, photos were collected around Vestmannaeyjar south of Iceland during summer, in co-operation with the Ocean Futures Society (OF) . This sampling was a part of a series of co-operative research projects between the MRI and OF on killer whales around Vestmannaeyjar, including studies on killer whale vocalisations, diving behaviour and genetics. Approximately 30 days were spent on photo-identification around Vestmannaeyjar in 2001.

Cetacean sightings data were collected from whale watching vessels operating in Icelandic coastal waters. This is a 4 year pilot project, initiated in 1999, for investigating the feasibility of using whale watching boats for systematic collection of data on distribution and relative abundance of cetaceans in near-shore Icelandic waters.

2.3 Laboratory work

Laboratory work on material sampled from stranded and by-caught cetaceans was continued. This includes determination of age, reproductive status and diet. Analysis of hormone concentrations and other blood parameters in fin and sei whales continued and screening was conducted for morbillovirus in stranded cetaceans. Analysis continued of MRI's photo-id catalogue of killer whales. The catalogue now contains more than 400 individual killer whales photographed during 1981-2001. Work continued on the Icelandic photo-id catalogue of blue whales focusing mainly on

comparison with blue whales from the western North Atlantic. Genetic analysis of biopsy samples from blue whales sampled west of Iceland continued. Laboratory work on 76 white beaked dolphin collected off Iceland in 1989-2001 was conducted. This includes determination of age, reproductive status and diet.

Genetic analysis of harbour porpoises collected off Iceland in 1991-1997 was continued. This is a collaborative project between the MRI and the Population genetics laboratory, University of Dublin.

3. CATCH DATA

Pinnipeds
Catch figures for 2001 are 611 harbour seals, 430 grey seals and 21 hooded seals.

Cetaceans
No direct catch of cetaceans were reported in Icelandic waters in 2001.

4. BY-CATCH DATA

No systematic reporting of by-caught marine mammals took place in 2001. A voluntary bycatch reporting system was established, and took effect from the start of the calendar year 2002.

5. ADVICE GIVEN AND MANAGEMENT MEASURES TAKEN

No whaling permits were issued in 2001. A precautionary TAC of 200 fin whales and 250 minke whales within the Icelandic EEZ was recommended by the MRI. These recommendations were based on recent assessment by the Scientific Committee of NAMMCO. No special management measures were taken regarding seals.

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4.4
NORWAY - PROGRESS REPORT ON MARINE MAMMAL RESEARCH 2001

(Sidsel Grønvik, Tore Haug & Nils Øien)

1. INTRODUCTION

This report summarises the Norwegian research on pinnipeds and cetaceans conducted in 2001. The research was conducted at the University of Tromsø: the Department of Arctic Biology (UITØ-AAB) and the Norwegian College of Fishery Science (UITØ-NFH), the University Hospital of North Norway (UNN), the Norwegian School of Veterinary Science, Department of Arctic Veterinary Medicine in Tromsø (NVH-IAV), the Institute of Marine Research in Bergen (IMR), the Norwegian Institute of Fisheries and Aquaculture in Tromsø (NIFA), the Norwegian Polar Institute in Tromsø (NP), the National Veterinary Institute (VI) and Origo Miljø as, Stavanger (OM).

2. RESEARCH

2.1 Species and stocks studied

Pinnipeds

Harp seals *Phoca groenlandica* - Greenland and Barents Seas
Hooded seals *Cystophora cristata* - Greenland Sea
Harbour seals *Phoca vitulina* - Svalbard, Norwegian coastal waters
Grey seals *Halichoerus grypus* - Norwegian coastal waters
Ringed seals *Phoca hispida* - Svalbard
Bearded seals *Erignathus barbatus* - Svalbard
Ross seal *Ommatophoca rossi* - Weddell Sea
Leopard seal *Hydrurga leptonyx* - Weddell Sea
Crabeater seal *Lobodon carcinophagus* - Weddell Sea
Weddell seal *Leptonychotes weddellii* - Weddell Sea
Antarctic fur seals *Arctocephalus gazella*-Bouvetøya
Southern elephant seals *Mirounga leonina* - Bouvetøya

Cetaceans

Minke whales *Balaenoptera acutorostrata* - Northeast Atlantic
Blue whale *Balaenoptera musculus* - Northeast Atlantic
Fin whale *Balaenoptera physalus* - Northeast Atlantic
Humpback whales *Megaptera novaeangliae* - North Atlantic
Pilot whales *Globicephala melas* - North Atlantic
Killer whales *Orcinus orca* - Northeast Atlantic
White whales *Delphinapterus leucas* - Svalbard
Harbour porpoise *Phocoena phocoena* - Norwegian coastal waters
Sperm whales *Physeter macrocephalus*- North Atlantic
White-beaked dolphins *Lagenorhyncus albirostris* - Northeast Atlantic

2.1 Field work

Pinnipeds

The ecology of seal pups (growth, changes in condition and diets) through the initial stages of their independent life, i.e. from weaning until they have started to feed independently, were studied during commercial seal hunting in the Greenland Sea (West Ice) in March-May. The pup ecology project includes both harp and hooded seals. Additional data on body condition were collected from adult harp seals (NIFA).

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 initiated with a pilot study in 1999. The project will continue in 2000-2002, preferably (i.e. if sufficient funding is obtained) as a joint effort for the four NAMMCO-countries. In 2001, a research cruise with R/V "Jan Mayen" along the ice edge and in the pack-ice east of Greenland between approximately N66°40’ and N72°30’ was performed in the period 13 February - 6 March. (NIFA)

In September, Norwegian and Russian scientists performed an aerial survey, using a specially designed Russian aeroplane, in the north-eastern Barents Sea to assess whether there was an overlap in distribution, and thus potential predation, between harp seals and capelin. The personnel in the plane co-operated with Norwegian and Russian research vessels, which assessed the distribution and abundance of capelin in the area simultaneous with the aerial survey. (NIFA)

UiTø-AAB personnel participated in a research cruise organised by NIFA to the Greenland Sea 13 February – 6 March 2001. The purpose of AAB activities was to collect blood samples from female pregnant harp and hooded seals and their foetuses, in order to study plasma melatonin levels. In addition, the heads of foetuses and adults (females) of both species were preserved, for later histological examinations of the pineal gland (which produces and releases the hormone melatonin). Finally, eyes of adult hooded seals were collected and preserved in liquid nitrogen for later studies of retinal photoreceptors and their role in regulating release of melatonin from the pineal gland (UITØ-AAB).

During a separate cruise (with a commercial sealer), 8 hooded seal weanlings were live-captured and brought to UITØ-AAB for laboratory studies of various aspects of their physiological adaptations to diving (see below). (UITØ-AAB)

Adult male ringed (n=7) and bearded (n=7) seals were shot for studies of pollution. (NP)

Haul-out behaviour of ringed seals in Svalbard was studied in order to develop correction factors for aerial surveys of hauled out seals. Around the clock counting of hauled out ringed seals, plus diurnal activity from 17 VHF- instrumented animals were combined with information on meteorological parameters to develop such correction factors. (NP)

Abundance estimation (using pup counts) and sampling of biological material for studies of breeding biology (including tagging of pups), in particular the temporal distribution of births, were performed for grey seals in ship borne surveys in Mid and North Norway in September - November. (NIFA)

Material to assess demographic parameters were collected from the Norwegian grey and harbour seal hunt. (NIFA)

In Rogaland County, harbour seals were surveyed in Lysefjord and around the islands of Håstein and Kjør in June. Grey seal pups were tagged in the Kjør area in December. (OM)

Attendance periods and foraging trips of lactating Antarctic fur seal females were studies at Bouvet Island. This was achieved by a combined use of satellite tags (n=3), time-depth recorders (n=10) and VHF-transmitters (n=40). Pup growth rates were monitored according to CEMP-monitoring procedures by weighing 50 random pups of each sex at day 30, 60 and 74 days of age. Pup production was estimated based on a mark-recapture experiment involving 1720 marked pups, resulting in a estimated pup production of 12,049 pups.
In addition material was collected for studies of pollution, diets and craniometry. (NP)

Weekly counts of hauled-out southern elephant seals were performed on Bouvetøya in the period Dec 25-2000 to Feb 23 2001. Highest number (Jan 11) was 350 animals. (NP)

UiTø-AAB personnel participated in the 2000/2001 Norwegian Antarctic Research Expedition (January-March. 69 days.) to the Weddell and Haakon VII Sea, for studies of the distribution and diving behaviour of Ross, leopard, Weddell and crabeater seals by use of satellite tracking/telemetry. In addition, blood, saliva and faecal samples were collected from a total of 49 Ross, Weddell and crabeater seals, for virological and bacteriological investigations (UITØ-AAB).

Incidental observations of marine mammals have been collected by IMR vessels and coastguard vessels. Recorded data include date, position, species and numbers.

Cetaceans

During the period 27 June to 7 August 2001 a sighting survey was conducted with one vessel covering the south-eastern Barents Sea including Russian EEZ and one vessel in parts of the Norwegian Sea. The latter vessel was originally planned to cover the North Sea but was denied access to UK waters. This was the sixth and final year of a six-year program to cover the north-east Atlantic to provide a new abundance estimate of minke whales every sixth year as part of the management scheme established for this species. During the survey biopsy samples were collected from several whale species (white-beaked dolphins, humpback, minke and fin whales), fluke photos were taken of humpback whales, and satellite tagging of large whales conducted. Instrumentation of minke whales with VHF tags for collecting dive time information was also conducted although not with any successful results. (IMR)

In August/September VHF tagging of minke whales was conducted in the Vestfjord area. Four whales were instrumented, and dive time data from three of these were collected. Biopsy samples from minke whales were also collected. (IMR)

Biological material, and especially material relevant for studying alternative age determination techniques for baleen whales, was collected during the commercial minke whale catch operations off Spitsbergen, Jan Mayen and in the North Sea. (IMR)

During the commercial whaling season (May-June), stomach samples, body condition data and biological material for studies of demography, reproduction and pollutants were collected from minke whales by scientific personnel on 4 of the participating vessels. Additionally, governmental inspectors collected tissue materials for studies of stock identity from all whales taken by the other vessels participating in the Norwegian small type whaling. (NIFA)

Five killer whales were instrumented with satellite tags in Tysfjord in November/December. (IMR)

Eight white whales were live-captured in Storfjorden in the latter half of October. Samples were taken for studies of pollution and genetics and 3 animals were instrumented with satellite tags to study winter movements. (NP)

Capture and satellite-tagging studies of harbour porpoises were carried out in Jarfjord (Varangerfjord) in June 2001 as a continuation of telemetric studies started in 1999. In 2001 three porpoises were tagged. (IMR)

In July an experimental survey for estimating abundance of harbour porpoises in coastal waters was conducted in Sognefjord and Romsdalsfjord in southern Norway. (IMR)

In August/September mapping of whale distributions was conducted during 0-group fish surveys in the Barents Sea. (IMR)

2.3 Laboratory work

Pinnipeds

Databases containing recapture information and incidental observations of marine mammals have been updated. (IMR)

Data on age and body condition and stomach samples from harp and hooded seals taken in scientific operations in pack ice areas in the Greenland Sea are being analysed. (NIFA)

A previous study has shown that brain temperatures of both harp and hooded seals may drop by several degrees in connection with simulated diving in the laboratory. This phenomenon may contribute to reduce diving metabolic rate, but the mechanism behind the brain cooling is still not known. Studies have continued, with the aim of identifying the mechanism(s) responsible. Thus, brain, rectal, and flipper vein and artery temperatures were recorded in harp and hooded seals that were subjected to simulated dives lasting for 10-15 minutes.

Studies have also been expanded to include investigations of the thermoregulatory consequences of body cooling during diving in seals, through measurements of shivering activity in connection with exposure to cold environments, as well as following dives causing body cooling, in hooded seals. In other mammals, a similar drop in body temperature would normally lead to activation of shivering thermogenesis to counteract the reduction in temperature. The question is whether shivering thermogenesis in response to body cooling is inhibited during diving in seals. A total of 56 experimental dives on 5 different hooded seals, where body temperatures, oxygen consumption and EMG-activity on large skeletal muscles were measured, have been performed. Results are being processed for publication.
Studies of thermoregulation during diving in seals at UITØ-AAB have so far been based on laboratory experiments. In collaboration with Institute of Arctic Biology at the University of Alaska, Fairbanks, we have developed equipment that in the future hopefully will enable us to measure body (brain) temperature in freely diving seals. (UITØ-AAB)

The insulative capacity of the fur of submerged phocid seals has been considered to be unimportant, but this has never been documented in sufficient detail. Measurements have been made of the thermal contribution of blubber, skin and fur of new-born and adult harp and hooded seals in air and in water, in order to asses their relative importance in the thermal protection for the animal (UITØ-AAB).

Laboratory studies of potential use of echolocation in harp and hooded seals have been completed. (UITØ-AAB)

Anatomical and histological studies of outer and middle ear structures of heads of hooded seals that had been fixed in formalin, were conducted in order to study adaptations to deep diving (UNN).

Clostridium perfringens toxinotypes in hooded seals in the Greenland Sea, polar bears and minke whales in Norwegian waters are determined by PCR and Elisa. (NVH-IAV, FU-Berlin)

Seroprevalence to Salmonella spp. in harp seals in the Greenland Sea is determined by Enzyme-linked Immunosorbent Assay. (NVH-IAV)

Occurrence of tumours in hooded seals is studied. (NVH-IAV)

Blubber and muscle samples from the North Atlantic populations of harp seals (n=15) and hooded seals (n=8) were analysed with respect to chlororganic pollutants (PCBs, DDTs, CHLs, HCHs and HCB). Publication of data in progress (VI-NVH).

Entire blubber layer samples from 9 obese and 7 lean harp seal were sectioned and analysed with respect to PCBs. Publication of data in progress (VI-NVH).

Data on age and body condition and stomach samples from grey seals taken for scientific purposes in North Norway are being analysed. (NIFA)

Demographic data from harp and hooded seals taken in commercial catches and from the Norwegian coastal grey and harbour seal hunt are being analysed. (NIFA)

Cetaceans

Studies of a number of alternative methods, including an evaluation of current methods for age determination of minke whales have been continued. (IMR)

Stomach content samples from minke whales have been analysed using traditional methods where the original biomass of prey items are reconstructed based on remaining hard parts in the contents. Acoustic and biological data from prey estimate surveys on the whaling grounds have also been analysed. (NIFA, UITØ-NFH)

Tissues sampled for stock identity studies of minke whales have been analysed using DNA techniques. (NIFA)

Samples from the North Atlantic populations of minke whales (n=20) were analysed with respect chlororganic pollutants. Both muscle and entire blubber layer samples were sectioned and analysed with respect to PCBs. Preliminary report is available at the Ministry of Fisheries. Publication of data in progress. (VI-NVH)

Specific blubber samples (tongue-, fin- and belly- blubber) from minke whales caught in the southern part of the North Sea and south of Spitsbergen in the Barents Sea were analysed with respect to PCBs, dioxins and polybrominated diphenyl ethers. A preliminary report is available at the Ministry of Fisheries. Publication of data in progress. (VI-NVH)

Pathological studies of minke whales killed by penthrite grenades were continued in 2001. Analysing and processing of the material will be finished and the results will be published in 2002 as part of a veterinary doctoral degree. (NVH-iAV)

Concentrations and patterns of OC contaminants in biopsy sampled material of white-beaked dolphins from the Barents Sea, Norway. Publication of data in progress (VI-NVH/HI).

Concentrations and patterns of OC contaminants in biopsy sampled material from blue whale, fin whale, humpback whale, sperm whale, killer whale and pilot whale from North Atlantic waters. Publication of data in progress (VI-NVH/HI).

Feeding and reproduction of harbour porpoises are being studied based on material collected in recent years from by-caught animals. (IMR)

Biological material (blubber, eye, teeth) were collected from a sperm whale stranded at Sola in south-western Norway. Fluke photos were compared with the sperm whale catalogue of Andenes, northern Norway, but no match was found. (IMR)

Databases containing incidental observations of marine mammals have been updated.(IMR)

2.4 Other work

In co-operation with the Directorate of Fisheries changes have been made to compulsory fisheries logbooks to accommodate recording of by-catches of marine mammals. (IMR)

Pinnipeds

Reproductive data from Greenland Sea harp seals have been analysed and presented. (NIFA, UITØ-NFH)

Data on grey seal breeding behaviour (pup stages, timing of births) have been analysed and presented. (NIFA)

Cetaceans

Data on temporal diet variations and prey selectivity of Northeast Atlantic minke whales have been analysed and presented. (NIFA, UITØ-NFH)

Data on white whale vocalisation (collected in Spitsbergen waters) have been analysed and presented. (NIFA, NP, UITØ-NFH)

Data on killer whale behaviour and ecology and problems concerning the use of photo-identification of the animals have been studied and presented. (NIFA, UITØ-NFH)

Scientists from IAV-NVH have been engaged in co-operative work with scientists, authorities, whale hunters and whale hunters organisations in Norway, Greenland, Alaska, and Japan to refine the design of hunting gears and penthrite grenades used for whale hunting, in the planning of workshops, preparation of manuals and lecturing for whale hunters and/or administrators in Norway, Greenland, Faroe Islands, Alaska (USA) and Japan.

2.5 Research results

Pinnipeds

A Norwegian – Russian aerial survey in September 2001 in the north-eastern Barents Sea aimed 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 aerial survey occurred concurrently with the annual Norwegian and Russian ship borne assessment of the distribution and abundance of capelin in the area. Preliminary results seems to indicate some overlap between the two species in September, in particular in areas east of Svalbard. (NIFA)

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 molting 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 results from these analyses were presented at the meeting in WGHARP in October 2000, and the data were used in the stock assessments. (NIFA, UITØ-NFH)

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 initiated in 1999. 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 in July/August in 2000. Results from analyses of stomach and intestinal contents from captured seals revealed that the diet of both species were comprised of relatively few prey taxa. Pelagic amphipods of the genus *Parathemisto* (most probably almost exclusively *P. libellula*), the squid *Gonatus fabricii* and the polar cod *Boreogadus saida* were particularly important. These three prey items constituted 73-98% of the observed diet in hooded seals and 95-99% in harp seals in terms of calculated biomass. *G. fabricii* was apparently the most important food item for both hooded and harp seals in September/October 1999 when intestine contents suggested that also polar cod was important for hooded seals, whereas *Parathemisto* was important for the harp seals. In July/August 2000, *Parathemisto* dominated the harp seal diet completely, whereas *G. fabricii* and polar cod constituted most of the hooded seal diet. A new expedition with "Jan Mayen" was conducted in the pack ice belt east of Greenland (mainly in the Denmark Strait) in February/March 2001. Again, the hooded seal diet was dominated by *G. fabricii*, whereas the polar cod appeared to have been replaced by capelin. Capelin was also important for the harp seals which menu also contained considerable amounts of *Parathemisto*. During the 2001 cruise, also various aspects of the digestion physiology of the seals were studied – this material is still being analysed. A final "Jan Mayen" cruise under the umbrella of this project is planned in the Greenland Sea in September/October 2002. Simultaneously with the sampling on dedicated cruises, it is intended that harp and hooded seals taken by local hunters in eastern Greenland and as by-catches in other fisheries in Iceland and the Faroes, shall be sampled for the same parameters in these countries. (NIFA)

Melatonin levels in blood samples from harp and hooded seal foetuses were found to be up to 7 times higher than in their respective mother, and this is unique in mammals. In other mammals the melatonin levels are always higher in the mother than in the foetus, and melatonin diffuses from the blood of the mother to the blood of the foetus. It is assumed that in this way a circadian pattern of physiological responses is transferred to the foetus. Why this relationship is reversed in harp and hooded seals is not known. Histological studies of formalin-fixed pineal glands are currently conducted using electron and light-microscopy. The absolute mass of pineal glands from foetuses and new-borns were up to 20 times higher than in sub-adults and adults,

and structures in the pineal tissue related to tissue activity were more abundant in the foetus and new-born pineal gland. (UITØ-AAB)

Studies of brain and other tissue temperature changes during diving in harp and hooded seals have confirmed previous findings of brain cooling in connection with diving in these animals. Analyses of tissue temperature data suggest that cooling is active and depends on peripheral flipper vasodilation during diving, accompanied by selective distribution of cooled blood to certain body regions. Studies of thermogenesis through muscular shivering in connection with diving in hooded seals show that the cooling during diving causes activation of thermogenic responses when the seal surfaces after the dive. However, the induced shivering is inhibited as soon as the seal dives again, even though the animal is still hypothermic. Thus, normal thermoregulatory responses are somehow inhibited during diving, thus allowing body temperature to drop. This response pattern allows the diving seal to save oxygen through body cooling, thereby presumably extending its dive capacity (UITØ-AAB)

Result from measurements of the relative thermal contribution of blubber, skin and fur in new-born and adult harp and hooded seals in air and in water show that the fur of both harp and hooded seals makes a crucial contribution to the thermal protection of pups in air, and also contributes considerably to the protection of adult animals in air. In water, the thermal insulation offered by fur is reduced by 90% but still contributes significantly to the protection of the newborn pup. This suggests that seals have fur (while whales have not) because they spend parts of their life in the terrestrial environment where fur has an important thermal function. (UITØ-AAB)

Studies of anatomical adaptations to deep diving in the middle and outer ears of hooded seals have continued. (UNN)

The distribution of organochlorines appears homogenous when comparing entire blubber layer samples at different body sites, for both pinnipeds and cetaceans (Severinsen et al., 2000, Kleivane et al., in prep, Holm et al., in prep). However, detailed study of inner and outer blubber layer expose various and non-homogenous distribution of these pollutants in blubber layer samples from harp seals (Kleivane et al., in prep.) and from minke whales (Kleivane et al., 2002). While a significant difference in $\sum PCB_{20}$ concentrations in entire blubber layer samples were found between pre-weaning (obese) and moulting seals (lean), no significant differences were found when comparing the total blubber burden of $\sum$PCBs (tbb$\sum PCB_{20}$) between the same seal groups, even though the net average blubber weight differed from 52 kg to 18 kg between groups (Kleivane et al. in prep.). These two findings counter the importance of standardising the sampling procedure and the evaluation of organochlorine analyses. Thus, in a standardised material (age, length, sex, nutritional and/or reproductive status) the total blubber burden approach is possibly an improved measure of comparison than plain sample concentrations when comparing OC results, especially in harp seals, and probably also in other species with remarkable seasonal variation in fat reserves (VI-NVH).

Lydersen et al. demonstrated in their study the weakness of blood as a matrix for monitoring purposes of lipophilic pollutants in seals (NP/VI-NVH).

Between 1975 and 1998, totals of 3,571 grey seal and 630 harbour seal pups were tagged at the Norwegian coast, and 259 (7%) grey and 79 (13%) harbour seal tags were returned, all from dead seals. Incidental mortality in fishing gear accounted for the majority of causalities (6% of all tagged seals in both species), mainly in bottom-set nets. The seals were most vulnerable to incidental mortality in fishing gear during the first three months after birth, but high incidental mortality prevailed during the first eight to ten months. Grey seals dispersed more widely (mean distance: 120 km) than harbour seals (mean distance: 69 km). Both species dispersed most widely during the two first months after tagging. The recorded maximum distance was 739 km for grey and 463 km for harbour seals, respectively. Strong site fidelity for their place of birth was observed in adult grey seals during breeding season. No significant difference in incidental mortality was detected between the areas of tagging, except for harbour seals tagged in Froan, a 724km2 nature reserve, where no recoveries where recorded. (IMR)

Analyses of stomach and intestinal contents and faeces were performed for grey seals in Finnmark and Lofoten, North Norway in March and September 1999 and in August-September in 2000. The results indicate that the grey seals fed mainly on gadoids (cod, saithe and haddock) and wolffishes. Other prey items of some importance in some areas were torsk, herring and flatfishes. The grey seals seemed to prefer small fish. The parasite fauna in the seal stomachs were also examined, and the results will be available soon. (NIFA)

The breeding biology of grey seals was studied in Finnmark in November-December 2000 and in November 2001. Preliminary results from these studies and previous data indicate that the breeding season extends over a period of 50-60 days, with a possible peak around 28 November – 1 December. Surveys aimed to assess the abundance of grey seals in mid Norway in September-October 2001 indicated increasing population size in this area. (NIFA)

Result from a ship-borne survey of harbour seals in Lysefjord in Rogaland County 24 June, revealed an observed breeding population of 45 adults and 9 pups. (OM)
Result from a ship-borne survey of harbour seals around the islands of Håstein and Kjør in Rogaland County 25 June, revealed an observed breeding population of 100 adults and 25 pups in Håstein and no one in the Kjør area. However 51 grey seals were observed in the Kjør area. (OM)

On 20th November, 15 new-born grey seal pups and one adult female were tagged on Kjør, and an additional 50 adult grey seals were observed in the area. On 11th December, 14 out of 15 grey seal pups were tagged. This day, 100 adults were observed in the area. (OM)

Satellite-linked dive recorders were deployed on 10 Ross seals in the Weddell and Haakon VII Seas, Antarctica. Data have been collected from 6 of these individuals

over an average period of 355 days, and show that this little studied species displays a pelagic lifestyle for large portions of the year, only returning to the pack ice to moult (February) and breed (November). Pilot studies using 2 leopard seals suggest that this species is associated to the pack ice for most of the year. (UITØ-AAB)

Cetaceans

The methods for analysing sightings survey data have been further developed with respect to combining multi-year survey data for Northeast Atlantic minke whales. (IMR)

Age estimation of minke whales based on reading growth zones in bullae has been shown to be of little use. This conclusion is based on experiments where several readers have done multiple readings of bullae sections and then compared to other length-related parameters like total length and number of ovulations. Growth structures in mandibles were also investigated but not found to be formed at a regular rate with poor agreement in within and between reader estimates. Age estimation of minke whales using the aspartic acid racemization reaction is apparently a promising technique. (IMR)

Substantial changes have occurred in the Barents Sea ecosystem over the past 30 years, the most conspicuous being related to the rises and falls of stocks of the two dominant pelagic shoaling fish species: capelin and herring. Based on data from annual studies, effects of these ecological changes on the diet and food consumption of minke whales have been assessed for the whole period 1992-2001. Following a collapse in the capelin stock in 1992/1993, minke whales foraging in the northern Barents Sea apparently switched from a capelin-dominated diet to a diet almost completely comprised of krill. The second half of the 1990s saw a clear improvement of the capelin stock, and the species was again observed on the whale menu in the northern areas in 2000. In the southern area of the Barents Sea capelin have been observed to be preyed upon by minke whales increasingly after 1995. In this area, also gadoids and, more importantly, krill and herring, are the food items of interest for the whales. The southern region of the Barents Sea include important nursery areas for the Norwegian spring spawning herring. Good recruitment to this stock gives strong cohorts (e.g., 1991, 1992 and 1998) and large numbers of young, adolescent herring (0-3 years old) which serve as the main food for minke whales feeding in the area. Recruitment failure with subsequent weak cohorts (e.g., 1993-1997) seems, however, to reduce the availability of adolescent herring to such an extent that minke whales switch to other prey items such as krill, capelin and, to some extent, gadoid fish. In the North Sea (first sampled in 2001), the whale diet appears to be dominated by sand eels. The annual changes in prey abundance and whale body condition, measured as girth and blubber index, was weakly correlated. Apparently, however, immature animals and adult females seemed to be in better condition in years with good abundance of immature herring in the southern Barents Sea. (NIFA)

In 1998 and 1999, stomach content samples from minke whales, caught during the Norwegian commercial whaling in the southern Barents Sea in the period May-June 1998, were compared with results from a comprehensive resource survey conducted

concurrently in order to identify and estimate the abundance of potential prey items for the whales. The small-scale resource surveys revealed significant variations in absolute and relative prey abundance both geographically and temporally. Similar variations were, to some extent, also observed in the whale diets. The results from the prey preference analysis gave evidence that the whales may have selected capelin actively. Gadoids (cod, haddock, saithe) appeared to have been avoided, while krill appeared to have been either avoided, fed randomly, or preferred, depending on sub area and analysis level. Herring was eaten as expected given the relative abundance of the species in the sea. The results from the 1998 and 1999 minke whale prey preference studies have served as basis for a PhD project. (NIFA, UITØ-NFH)

Based on tissues collected for scientific purposes during Norwegian and Greenland whaling operations in 1998, questions concerning minke whale stock identity were addressed in a joint Greenland-Norwegian program. The methods applied included analyses of DNA, organochlorines, heavy metals and fatty acid signatures. The results, which are now being published, may indicate some sub-structuring of minke whales within the entire study area, e.g., with animals from the North Sea possibly being different from animals taken elsewhere in the north-east Atlantic. (NIFA, IMR)

Pollutant analyses in blubber of a total of ten adult minke whales (females), five of which were harvested in the south North Sea area (IWC/EN-area) and five of which were harvested in the Barents Sea /Spitsbergen area (IWC/ES-area), reveal a surprising and apparent geographical difference between regions. The levels of polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) (hereafter called dioxins) and dioxin-like PCBs (non-ortho PCB and mono-ortho PCBs) were analysed in three different types of blubber (tongue blubber, dorsal blubber and abdominal blubber) from each animal. In addition, the congeners included in the $\sum PCB_{35}$ and $\sum PCB_{7}$ were analysed. Large variations in $\sum PCB_{35}$ contamination were found between individuals despite the fact that only adult females were used in this study. However, contamination levels are well within the ranges found in previous studies. As predicted, the lowest concentrations of these substances were found in the tongue blubber, which contains a significantly lower percentage of fat than the two other types of blubber. In this study, new findings emerged regarding a clear geographical variation in the $\sum PCB_{35}$ contamination found in minke whale blubber, with the lowest concentrations in the animals harvested from the Barents Sea/ Spitsbergen area. The mean concentrations of $\sum PCB_{35}$ in tongue, back and abdominal blubber obtained from Barents Sea/Spitsbergen area were 288 ng/g, 461ng/g and 456 ng/g wet weight, respectively. Whereas mean concentrations of PCB_{35} in tongue, back and abdominal blubber obtained from the southern North Sea area was 1332 ng/g, 2186 ng/g and 2409 ng/g wet weight, respectively. These variations are likely to be associated with reproductive biology and variations in the migratory patterns of the minke whale. Little is known about either of these variables. However, ongoing studies may reveal different sub-populations of minke whales in the presented material. This study reconfirms that findings from dioxin analysis will be of minimal significance to risk assessment of minke whale blubber, since dioxins contribute on average only four per cent of the total toxicity (TE). Non-ortho and mono-ortho PCB congeners contribute more or less equally to the overall toxicity. The toxicity

contribution of dioxin-like PCBs should therefore provide a sufficient basis for risk assessment efforts. If the levels of such substances in minke whale blubber are to be monitored in the future, it is advisable to consider whether the analysis methodology can be simplified. This study finds that analysis of a single PCB congener, PCB-153, may be a good indicator of PCB_7 and PCB_{35} as well as the overall toxicity of PCBs and dioxins combined. Quality control measures for and standardisation of sampling methods should be devised. (VI-NVH)

Two killer whales tagged in December 2000 were followed for three and five months. They followed the migrating herring southwards to the spawning grounds off West Norway, and then north-westwards into the Norwegian Sea herring feeding grounds in April/May. Dive time patterns have also been collected, showing that the killer whales spent most of the time in the upper 28m layer of water although dives down to the interval 352-400m were recorded. (IMR)

Experiments to use by-caught harbour porpoises for satellite tagging have been successful, and three animals were tagged in June 2001. (IMR)

The population structure of harbour porpoises in Norwegian waters has been investigated by genetic and ecological methods applied to samples from porpoises incidentally by-caught or stranded. The results support to a certain degree the population divisions in the North Atlantic as suggested by the International Whaling Commission, but some refinement leading to a finer scale division seems to be necessary for the North Sea region. (IMR)

3. CATCH DATA

Sealing

Three Norwegian vessels participated in the commercial harp and hooded seal catches in 2001, two in the West Ice (the Greenland Sea) and a third in the East Ice (the south-eastern Barents Sea). All quotas were permitted taken as weaned pups subject to prescribed conversion factors between pups and 1+ animals. Table III.I shows the Norwegian catches of harp and hooded seals in 2001. These catches represent only fractions of the quotas: In the West Ice only 12.5% of the harp seal quota and 27% of the hooded seal quota were taken. In the East Ice the Norwegian vessel caught its allocated harp seal quota, but the total result based on both Russian and Norwegian catches was 39% of the quota recommended by the Joint Norwegian-Russian Fisheries Commission (53,000 1+ animals).

Table III.1. Norwegian catches of harp and hooded seals in 2001. 1+ means one year old or older seals.

Catching area:	*The West Ice*			The East Ice		
Species	Pups	1+	Total	Pups	1+	Total
Harp seals	2,267	725	2,992	330	4,870	5,200

Hooded seals	3,129	691	3,820			

Whaling
After a temporary suspension, the traditional small type Norwegian minke whaling was again permitted in 1993 and quotas were implemented based on the Revised Management Procedure (RMP) developed by the International Whaling Commission's (IWC) Scientific Committee. The RMP allocates catch quotas to specific management areas. There are five such management areas within the region of interest to Norwegian whalers. These are (1) the Svalbard-Bear Island area (coded ES), (2) the eastern Norwegian Sea and the central and north-eastern Barents Sea (EB), (3) the Lofoten area (EC), (4) the North Sea (EN) and (5) the western Norwegian Sea-Jan Mayen area (CM). Table III.2 shows the number of minke whales taken by area in the 2001 season.

Table III.2. Quotas and catches of minke whales in 2001 by management area as defined in RMP.

2001	*Management area*					
Small-type whaling	EB	EN	ES	EC	CM	Total
Catch	262	128	120	11	31	**552**
Quota	260	127	120	11	31	549

4. ADVICE GIVEN AND MANAGEMENT MEASURES TAKEN

Sealing
Advice on the management of harp and hooded seals is based on deliberations in the ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP). At its most recent meeting in the fall of 2000, WGHARP assessed West and East Ice harp seals and West Ice hooded seals. The management agencies requested advice on “sustainable” yields for these stocks. “Sustainable catch” as used in these yield estimates for seals means the catch that is risk neutral with regard to maintaining the population at its current size. The population assessments were based on a population dynamics model that estimates the development of future population size, for which statistical uncertainty is provided for the catch options. The age structure of the model was restricted to two age classes, 0 (pups) and 1+(one year old or older), because of limited information on catch at age and age structure for the populations in question, and because of the fact that catches were rather small compared to population size for the years for which catch at age is known. The model requires estimates of mortality and reproductive parameters that include variance. Using the historical catch data and estimates of pup production, the model estimates mortality (M_0 and M_{1+}) and a birth rate within the 1+ population of females' (f). The freedom with which the model can estimate these parameters is dependent upon the standard deviations provided. The model is fitted to pup production estimates weighted inversely to their variance in

cases where more than one estimate are available. The possibility of including multiple pup production estimates in the assessment model is an improvement from previously used estimation programs. However, models of this nature do not estimate parameters well when pup production estimates are from a limited period in time compared to generation time. The model has the option to allow estimation of population size and sustainable catch, but when given no prior information about M_{1+} and f, the model treats these parameters as independent parameters. To stabilise the model, the range of these parameters had to be constrained. As a result, the estimates of uncertainty may be negatively biased, and the confidence intervals for future population sizes may be too narrow.

Based on the assessments performed by WGHARP, the ICES Advisory Committee on Fishery Management (ACFM) provided advice on quotas for the 2001 season. The recommended sustainable TACs were set as follows: Harp seals in the East Ice 53,000 1+ equivalents, harp seals in the West Ice 15,000 1+ equivalents, and for hooded seals in the West Ice 10,300 1+ equivalents. If pups are to be taken, 2.5, 2 and 1.5 pups are equivalent to 1 one year old or older seal for the three stocks respectively. There were no WGHARP meeting in 2001, and there is, therefore, no new advice from ACFM for the 2002 season. For this reason, the advice given for 2001 were prolonged to apply also for the 2002 sealing season. Traditionally, both Russia and Norway have participated in the sealing operations in the West Ice and the East Ice and have, therefore, allocated quotas on a bilateral basis in negotiations in the Joint Norwegian-Russian Fisheries Commission. However, the Russians cancelled their sealing operations in the West Ice in 2001. The Norwegian shares of the 2002 quotas will be 15,000 harp seals and 10,300 hooded seals in the West Ice (the total quotas in this area) and 5,000 harp seals in the East Ice (all given as 1+ equivalents). There is a general ban on catching females in the breeding lairs in the West Ice. The Norwegian ban on catching pups of the year, introduced in 1989, was lifted from the 1996 season onwards, and weaned pups can now be taken.

In 1996 new regulations for the “sustainable” hunt of coastal seals as well as compulsory catch reports were introduced. Quotas have been set based on the available information on abundance and allocated along the coast according to abundance within counties (common seals) or regions (grey seals). The total 2001 quotas were 508 harbour seals and 625 grey seals. Of this, 466 harbour seals (92% of the quota) and 105 grey seals (17% of the quota) were taken. The quotas set for coastal seals for 2002 are 355 grey seals and 504 harbour seals.

Whaling

At the IWC Annual Meeting in 1992 Norway stated that it intended to reopen the traditional minke whaling in 1993. So far, IWC has accepted the RMP developed by its Scientific Committee as a basis for future management decisions but has not implemented the procedure. The Norwegian Government therefore decided to set quotas for the 1993 and following seasons based on RMP, with parameters tuned to the cautious approach level as expressed by the Commission and using the best current abundance estimates as judged by the IWC Scientific Committee.

The total quota for the north-east Atlantic and the Jan Mayen area in 2001 was set to 549 minke whales (Table III.2). Since a new five-year quota period was started in 2001, whales not taken under the previous year's quota could not be transferred. The catch quotas are set for each of five management areas, and allocated on a per vessel basis with some over-regulation which means that there also is some competition between vessels for the total quota. The basic catching season was from 14 May to 31 July with the exception of the North Sea where the season was extended to 31 August. All the participating vessels had inspectors on board to survey the whaling operation.

RMP essentially sets a five year block quota where animals not taken a particular year may be transferred to later years within the block. A new quota period was started in 2001. For 2002 a total quota of 671 has been set with the following Small area allocation: EB 318, EN 155, ES 148, EC 14 and CM 36.

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NAMMCO SCEINTIFIC WORKSHOP ON MODELLING MARINE MAMMALS - FISHERIES INTERACTIONS IN THE NORTH ATLANTIC

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